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THE

BOMBARDIER,

AND

POCKET GUNNER.

Serafino Roqueb. 1820

BY

RALPH WILLETT ADYE,

CAPTAIN, ROYAL REGIMENT OF ARTILLERY.

EIGHTH EDITION,

Revised and Corrected, according to the Present System, by

WILLIAM GRANVILLE ELIOT,

BREVET MAJOR, ROYAL HORSE ARTILLERY

London:

PRINTED FOR T. EGE[illegible]

BOOKSELLER TO THE O[illegible]

MILITARY LIBRARY, WH[illegible]

1827.

PRINTED BY G. HAYDEN,
Little College Street, Westminster.

TO

THE JUNIOR OFFICERS

OF THE

ROYAL REGIMENT OF ARTILLERY,

WITH A HOPE OF ALSO MEETING

THE APPROBATION

OF THE

SENIOR OFFICERS OF THAT CORPS.

R. W. ADYE.

PREFACE

HE Seventh Edition of The Pocket Gunner aving long been out of print, I have again un-rtaken to revise an Eighth, on the plan of the iginal Work, compiled by the late Major Ralph illett Adye, to whom the Regiment of Artillery ust ever feel indebted for information, which fficers were previously obliged to collect, with uch trouble and pains, from a variety of sources: nd it is still to be regretted, that no general Manual of Artillery exists in the British Service, or the guidance of the Officers and Non-Com-missioned Officers of Artillery; every one being obliged to acquire information, either from ex-perience, from the memoranda kept by individuals, or from Itemarkt, and other Treatises, which have been, from time to time, very sparingly published.

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materiel of Artillery has not been entirely wit drawn from the service, (although eventually be superseded by new) the details of both a given. The Field Battery Exercise, which is n in course of experiment, and not finally promu gated to the Regiment at large, it has not be thought advisable to include, particularly as present bulky form would far exceed the limits a *Pocket Gunner*, the intent of which is to remin more than to instruct. Much useful matter, whi would have increased the size of the present Wo and which might, with more propriety, be intr duced in a Treatise on Gunnery or Artillery, h been rejected.

Note.—Since the whole of this Edition of The Pock Gunner has been printed off, a course of practice has be ordered with 6 and 12-pr. rockets, and new tubes for firi them through have been adopted for the purpose. The tubes are not more than half the length of the old on and, consequently, the ranges with the same elevation a shorter; for example, the 12-pr. rocket ranged about 10 yards with from 11 to 12 degrees, according to the dire tion of the wind; the new 12-pr. tube requires from 13 14 degrees elevation for the same distance: but sufficie practice has not yet been made with them to give a gener rule for all distances, and the one under the head of Roc ets, is applicable only to the long jointed tubes of 20 feet.

AMMUNITION—For small arms, in the British service, is generally packed in half barrels, each containing 1000 musquet, or 1500 carbine cartridges. An ammunition waggon will carry 20 of these barrels, and an ammunition cart 12 of them: their weight nearly 1 cwt. each.

The cartouch boxes of the infantry are made of so many different shapes and sizes, that it is impossible to say exactly what ammunition they will contain; but most of them can carry 60 rounds. See the word *Cartridges*; and for Artillery Ammunition, see the word *Artillery*, for the field, for the siege, and the defence of a fortified place.

The French pack all their ammunition in waggons, without either boxes or barrels, by means of partitions of wood. —Their 12-pr. and 8-pr. waggons will contain each 14000 musquet cartridges, but their 4-pr. waggons will contain only 12000 each.

AMMUZETTE.—See the word *Guns*.

AMPLITUDES, Table of.—See *Gunnery*.

APRONS—of lead for guns—

		lb.	*oz.*	
Large—1 foot long—	10 inches wide—	8	4	weight.
Small—6 In. ———	4½ ———————	1	12	———

Arms—Small.

Nature.	Length of Barrel.	Diam^r. of Bore.	Balls weight	
			Proof.	Service.
	Ft. In.	Inches.	oz. dr. gr.	oz. dr. gr.
Wall pieces	4 6	·98	2 8 8	2 5 7
Musquet	3 6	·76	1 6 11½	1 1 12
Carbine	3 0	·61	0 14 13	0 12 11
Pistol, common	1 2	·58	0 8 15	0 7 4
Ditto—carbine	1 0	·66	0 14 13	0 12 11

ARTILLERY.—The proportion of artillery and ammunition necessary to accompany an army in the field, to lay siege to a fortified place, or to defend one, must depend upon so many circumstances, that it is almost impossible in a small work of this kind, to lay down any satisfactory rules as guides on the subject: the following principles are however, drawn from the best authorities:

1st. *Artillery for the Field.*

Field Artillery is divided into Troops of Horse Artillery of 6 pieces each; Batteries of Foot Artillery of 6 pieces; and Artillery of the Park, according to the nature of the warfare. For their equipment, *see the words Field Battery and Troop.*

The British *Horse Artillery* had, during the last war five

e light 6-pounders, and one light 5½ inch howitzer atıched to each troop. On the present peace establishment ch troop has only two guns in England and four in Irela

Tl *ield Batteries of Foot Artillery* have either five nedium 12-pounders and a 24-pounder howitzer, five -pounders, and a 24-pounder howitzer, or five light -pounders, and a 12-pounder howitzer. The 24-pounders nd 12-pounder howitzers are new in the service, and introced by Major General Miller, in lieu of the old 5½ heavy d light howitzers, the latter of which was considered as a ry inefficient piece of ordnance. The 9-pounder gun proved in the Peninsular campaigns to be a better gun o oppose to the French 8-pounder than the light 6-pounder, and has been very generally adopted for field batteries. At the battle of Waterloo, a battery formed entirely of howitzers was found very efficacious.

The *French* Horse Artillery consists of 8-pounders and -inch howitzers.

The *Austrian* and *Prussian* Horse Artillery have 3-ounders and 5½ inch howitzers.

The *Field Batteries of Artillery* lately fitted out and sent Portugal, consist of three 9-pounders and a 24-pounder owitzer each.

Gen. L'Espinasse, who commanded the French artillery n Buonaparté's campaigns in Italy, proposed the following oportion of guns to Infantry and Cavalry:

He

He takes a division of the French army to consist 12,000 men, including a regiment of *Chasseurs à Che* and one of *Hussars:* to these, he attached 36 pieces of cannon of different natures, according to the country and means of transport; 6 guns of foot artillery and 6 of horse marched with the 12,000 men. The same number each, with horses, &c. complete, remained at the park of the division, and a like number of each, equally complete for service, remained at a moveable depôt in the rear of the park; so that he had 1 piece of ordnance in action with 1000 firelocks; and it could be re-placed twice in the event of being taken, or the pieces in action could be augmented, if necessity required.

To a reserve of cavalry of 6000 men, attached to two divisions of infantry, or 24,000 men, he allowed 18 pieces of horse artillery, distributed as before, in line, at the park, and in depôt. Each division had its park, which was supplied from its own depôt; and the depôt was re-established with stores, &c. from the general park.

Frederick the Great employed, in most of his campaigns, a very large proportion of artillery. In the seven years war, one *bouche à feu* was attached to every 250 men. Marshal Saxe proposed to employ two 12-pounders and 1[illegible] ammuzettes to 3258 infantry.

Louis XIV. had only one *bouche à feu* to 1250 men.

At Aspern and Esling, and at Wigram, the Austrian force consisted of about 75,000 men, to which were at-

tached

2515

tached 18 batteries of brigade, thirteen of position, and 11 of horse arrillery, making together 42 batteries amounting to 280 *bouches à feu*; being in the proportion of one to 260 men nearly.

Napoleon Buonaparté employed, with an army of 400,000 infantry and 60,000 cavalry, for the invasion of Russia, 1200 pieces of artillery; being in the proportion of one gun to 383 men.

General Dombrowski's division of 6,000 men, on the Berezina, Nov. 1812, had 20 pieces of cannon, being one to 300 men.

The troops which ought to have united under Marshal Oudinot to oppose Admiral Tehichagow amounted to 20,000 men, with 60 *bouches à feu*; being nearly in the same proportion.

Napoleon, in 1813, had 1400 pieces of artillery, with 300,000 men, being one to 200 nearly. In 1815, to 130,000 infantry and 20,000 cavalry, he had 300 *bouches à feu*, being one to 500 men.

The British army in Spain, May 1813, consisted of 65,000 and 90 pieces of artillery, including that of the reserve, being one *bouche à feu* to 500 men.

At the battle of Albuera, Marshal Beresford had 29,000 men, and 32 pieces of artillery; being one gun to 900 men. Marshal Soult, in the same action, had 23,000 men and 40 pieces of cannon, being one to 575 men.

The French army, on the Tormes, in December 1812

amounted to 80,000 men and 200 pieces of artillery, being one gun to 400 men.

Lord Hill's division of 20,000 men had 24 pieces of cannon, being one to 833 men.

The French army at Vittoria, consisting of 50,000 men, had 150 pieces of cannon, being one to 325 men.

By the foregoing remarks, it will be seen, that the proportion of guns to men varies, from about one gun to 250 men, to one to 800; and that British armies in general have less artillery than others. A medium perhaps would be better; for example, one *bouche à feu* to 350 or 400 men at most, according to the nature of the country in which a campaign is to be carried on.

Artillery of the Park.—The Park of Artillery, in addition to a requisite proportion of light guns, to replace such as may be disabled or taken, ought to contain a proportion of ordnance of a heavy calibre, such as 18-pounders, 12-pounders, and 8-inch howitzers, for the purpose of forming batteries of position, defending entrenched posts, breaking down bridges, dislodging an enemy from temporary works, or old castles, fortified in order to impede the march of an army for a short time. It is not absolutely necessary that those of the heaviest calibre should follow the army in all its movements, but they may be brought up as near to it as circumstances will admit of; and in general and decisive actions, would be found of the greatest utility.

On the supposition that every division of the army has

its

its own particular park, the general park might then be composed of guns of the above natures, in the proportion of one 18-pounder and one 8-inch howitzer to each division of the army. It should likewise contain spare carriages, stores, and ammunition for every description of ordnance to be employed; a pontoon, or boat equipage; and a moveable magazine, in waggons or carts, for the infantry and cavalry. According to the *Aide Memoire*, the grand park should contain $\frac{1}{16}$ of the number of guns, with the divisions, and $\frac{1}{10}$ of spare carriages.

ARTILLERY, Park of—should always be placed, if possible, within a short distance of water-carriage, and have the most ready communication with every part of the line of the army. Its form must depend on its situation. Ten feet are usually allowed in front for one carriage and its interval, and near 50 feet from the hind wheels of the front row to the fore wheels of the second; this interval should allow sufficient room for putting the horses to the carriages, and for a free passage along the line.—In parks not on immediate service, it is customary to arrange the guns with their muzzles to the front; but where the guns are likely to be wanted at a short notice, appearances must not be studied, and the gun carriages must be parked with their shafts to the front, ready to receive horses to them.—A quarter-guard is placed in front of the park, and the non-commissioned officers and gunners' tent, on the flanks,

at about 20 paces distant; and 40 paces to the rear the subaltern officers; at 10 more to the rear the captains, and 10 more the commanding officer.—The mess tent is 15 in the rear of the officers.—At a convenient distance in the rear of the whole, are the horses, picketed in one or more lines, with the drivers on their flanks.—The horses are sometimes picketed in lines perpendicular to the front, and on the flanks of the carriages, between the men and the carriages.

The ammunition for batteries of Field Artillery in the British service, according to the latest establishment, is carried in the manner expressed in the following tables:

Medium 12-Pr. with Ammunition Limber Carriage.

			Round Shot.	Com^n Case.	Spherical Case.	Total of Shot.	Cart^gs 4 *lbs.*	Cart^gs 4½ *oz.*
Gun Limber 2 Boxes			10	2	..	12	12	..
Amm^n Carr^ge	Limber 2 Boxes		24	8	..	32	32	..
	Body	Fore Box....	12	..	8	20	20	8
		Hind Box ...	16	4	..	20	20	..
Total..			62	14	8	84	84	8

N.B. A new 12-pounder limber has been constructed, with a small middle box to carry 6 spherical case shots in addition to the above. The gun carriage has likewise additional trunion holes for the march.

9-Pounder, with Ammunition Limber Carriage.

	Round Shot.	Comn Case.	Spherical Case.	Total of Shot.	Cartgs 3 lbs.	Cartgs 3½ oz.
Gun Limber, 2 Boxes....	26	6	..	32	32	..
Ammn Carrge — Limber, 2 Boxes	26	6	..	32	32	..
Ammn Carrge — Body — Fore Box	12	4	12	28	28	12
Ammn Carrge — Body — Hind Box....	24	..	..	24	24	..
Total..	88	16	12	116	116	12

Note.—All field ordnance under the medium 12-pr. use the same Limber as the light 6-pounder.

Heavy 6-Pounder, with Ammunition Limber Carriage.

	Round Shot.	Comn Case.	Spherical Case.	Total of Shot.	Cartgs 2 lbs.	Cartgs 2½ oz.
Gun Limber, 2 Boxes	40	10	..	50	50	..
Ammn Carrge — Limber, 2 Boxes	40	10	..	50	50	..
Ammn Carrge — Body — Fore Box	25	10	10	45	45	10
Ammn Carrge — Body — Hind Box	35	..	10	45	45	10
Total..	140	30	20	190	190	20

Light

Light 6-Pounder, with Ammunition Limber Carriage.

			Round Shot.	Com^n Case.	Spherical Case.	Total of Shot.	Cart^s 1½ *lbs.*	Cart^s 2½ *oz.*
Gun	Carriage, 1 Box		8	..	..	8	8	..
Gun	Limber, 2 Boxes		32	10	..	42	42	..
Amm^n Carr^ge	Limber, 2 Boxes		32	8	..	40	40	..
Amm^n Carr^ge	Body	Fore Box	25	10	10	45	45	10
Amm^n Carr^ge	Body	Hind Box	35	..	10	45	45	10
Total..			132	28	20	180	180	20

Heavy 3-Pounder, with Ammunition Limber Carriage.

			Round Shot.	Com^n Case.	Total of Shot.	1lb. Cartridge.
Gun	Carriage, 1 Box...		12	..	12	12
Gun	Limber, 2 Boxes ..		45	15	60	60
Am^n Carriage	Limber, 2 Boxes...		45	15	60	60
Am^n Carriage	Body	Fore Box ..	48	12	60	60
Am^n Carriage	Body	Hind Box..	48	12	60	60
Total..			198	54	252	252

Light 3-Pounder, with Ammunition Car.

	Round Shot.	Common Case.	Total of Shot.	12oz. Cartridges.
Gun Limber, 1 Box	24	6	30	30
Ammunition Car, 2 Boxes	44	16	60	60
Total..	68	22	90	90

Heavy 5½-Inch Howitzer, with Amm. Limber Carriage.

			Com^n Shells.	C. Shot.			Total Rounds.	Cart^gs		
				Common.	Spherical.	Carcasses.		2 *lbs.*	10 *oz.*	6 *oz.*
How^r L^r	Off Box		8	2	..	..	10	10	8	..
How^r L^r	Near Box		8	2	..	..	10	10	8	..
Am^n Carr^ge	Limber	Off Box..	11	..	..	..	11	11	11	..
Am^n Carr^ge	Limber	Near Box	11	..	..	..	11	11	11	..
Am^n Carr^ge	Body	Fore Box	10	2	4	2	18	18	10	4
Am^n Carr^ge	Body	Hind Box	10	2	4	2	18	18	10	4
		Total..	58	8	8	4	78	78	58	8

24-*Pr.*

24-Pounder Brass Howitzer.

	Comⁿ Shells.	C.Sh. Common.	C.Sh. Spherical.	Carcasses.	Total Rounds.	Cartⁿ 2½ *lbs.*	Cartⁿ 10 *oz.*	[illegible]
Howitzer Limber, 2 Boxes	12	6	6	..	24	24	12	[illegible]
Amⁿ Carriage { Limber, 2 Boxes	12	6	6	..	24	24	12	[illegible]
Amⁿ Carriage { Body, 2 Boxes..	24	..	6	6	36	36	24	[illegible]
Total..	48	12	18	6	84	84	48	[illegible]

12-Pounder Brass Howitzer.

	Comⁿ Shells.	C. Shot. Common.	C. Shot. Spherical.	C. Shot. Carcasses.	Total Rounds.	Cartᵍˢ 1½ *lbs.*	Cartᵍˢ 5 *oz.*	Cartᵍˢ 4½ *oz.*
Howitzer Limber, 2 Boxes	18	6	12	..	36	36	18	12
Amⁿ Carrᵍᵉ { Limber, 2 Boxes	18	6	12	..	36	36	18	12
Amⁿ Carrᵍᵉ { Body, 2 Boxes..	28	..	28	8	64	64	28	28
Total	64	12	52	8	136	136	64	52

The

The following is the Proportion of Ammunition which may be carried by each common Pattern Waggon.

	Round Shot.	C.Sh. Common.	C.Sh. Spherical.	Com^n Shells.	Carcasses.	Total.	Cartridges.
12-Pounder Medium........	60	12	8	..	..	80	80
9-Pounder	82	18	10	..	..	110	110
6-Pr. heavy or light	112	24	14	..	..	150	150
3-Pounder, ditto ditto......	210	46	24	..	..	280	280
5½ Howitzer		8	8	60	4	80	80

Positions and Movements of Field Batteries of Artillery.

In a *defensive* position the guns of the largest calibre must be posted in those points from whence the enemy can be discovered at the greatest distance, and from whence may be seen the whole extent of his front.

In an *offensive* position, the weakest points of the line, and those most distant from the enemy, must be strengthened by the largest calibres. Those heights, on which the army in advancing may rest its flanks, must be secured by them, and those from whence the enemy may be fired upon obliquely.

The guns should be placed as much as possible under cover. This is easily done upon heights, by keeping them so far back, that the muzzles are only to be seen over them. By proper attention, many situations may be found of which advantages may be taken for this purpose; such as banks, ditches, &c. every where to be met with.

A battery in the field should never be discovered by the enemy till the very moment it is to open. The guns may be masked, by being a little retired, or by being covered by troops, particularly cavalry.

To enable the commanding officer of artillery to choose the proper positions for his field batteries, he should of course be made acquainted with the effect intended to be produced; with the troops that are to be supported; and with the points that are to be attacked; that he may place his

his artillery so as to support, but not incommode the infantry; nor take up such situations with his guns as would be more advantageously occupied by the line. That he may not place his batteries too soon, nor too much exposed; that he may cover his flanks and his front, by taking advantage of the ground; and that he may not venture too far out of the protection of the troops, unless some very decided effect is to be obtained thereby.

The guns must be so placed as to produce a cross fire upon the enemy's position, and upon all the ground which he must pass over to attack you. It may sometimes be necessary, in order to concentrate a cross fire on one particular point, to sub-divide your batteries: thus his fire may be attracted to different objects, whilst your own is directed to one point; which may be the *debouchés* of the enemy, the head of his columns which menace you, or the ground in front of the weakest point of your line.

In an attack of the enemy's position, as your own troops advance, your fire must become direct, otherwise it would impede their advance; and when you can no longer fire on the point to be attacked, the guns must be directed on the collateral points.

The shot from artillery should always take an enemy in the direction of its greatest dimension; it should therefore take a line obliquely or in flank, but a column in front.

Artillery should never be placed in such a situation that it can be taken by an enemy's battery obliquely, in flank,

or in the rear, unless a position, under these circumstances, offers every prospect of producing a most decided effect, before the guns can be destroyed or placed *hors de combat.*

The most elevated positions are not the best for artillery: the greatest effects may be produced from a height of 30 or 40 yards at the distance of about 600, and about 16 yards of height to 200 of distance.

Positions in the rear of the line are bad for artillery, because they alarm the troops, and offer a double object to the fire of the enemy.

Positions which are not likely to be shifted, but from whence an effect may be produced during the whole of the action, are to be preferred; and in such positions a low breast work of 2 or 3 feet high may be thrown up, to cover the carriages.

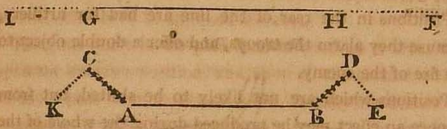
Artillery should very rarely be placed in front of the line, or distributed by batteries in the intervals. When the line is of great extent, it may then become necessary to place a strong battery in the center: this should be composed of the guns of the heaviest calibre, and it should be posted in the interval between the right and left wing, by which means it does not offer a double object for the enemy to fire at.

An army in order of battle may be considered as the front of a fortification, of which the lateral batteries are the bastions, and the infantry the curtain. It is under the protecting fire of these batteries, or imaginary bastions, that

that the troops manœuvre freely, and advance to the attack of an enemy, who is himself prevented from moving by the cannon which he has placed in his front for his defence.

The two following dispositions may serve to illustrate the foregoing observations:

1*st.* On the lateral position, taken from L'Espinasse's *Essai sur l'Artillerie.*



AB the French army under Gen. Buonaparté, at the battle of Castiglione, 5th August, 1796; GH the imperial army under Field Marshal Wurmser; AC the battery of 12 pieces of foot artillery, sustaining the left of the French army on the heights in advance of Castiglione; BD the battery of 20 pieces of light artillery appuying on the right which extended in the plain; the line AB of infantry, being taken for the curtain, the batteries AC and BD represent the faces of the bastions of this front, which cross their fire before the curtain, and consequently cover the troops from an attack, whilst they take the enemy in escarp.

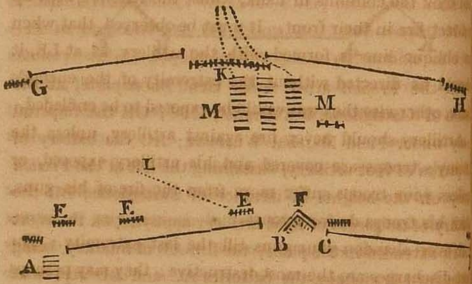
Wurmser having prolonged his right from G to I, as represented by the dotted line, in order to outflank the French, Gen. L'Espinasse took some of the guns from CA, and placed them on the line CK, until others could be drawn

 for

for that purpose from the park; thus forming a new battery, destined to follow the movements of the enemy. Another battery was likewise formed on the right from D to E, in case Wurmser had prolonged his left from H to F.

2nd disposition, when the line is of too great an extent to cover the whole of the front by lateral batteries of position.

Battle of Talavera.



At the commencement of the battle, the British artillery were stationed by batteries of 6 guns, with the divisions to which they were attached; a temporary redoubt, unfinished, was thrown up at F, in which was posted a battery of 3-pounders; on the hill, at A, the most commanding point, were two batteries, one of heavy 6-pounders, the other

other of light sixes, and two Spanish guns afterwards were added to them.

The French had a battery of 14 guns in the centre at K, and others at G and H, independent of others which were brought up during the action. On the second day, when the columns at M advanced, supported by artillery, to the attack of the British right, which appuyed on the unfinished redoubt, the three brigades from EEE were formed in an oblique line from L to E, as represented by a dotted line, and took the columns in flank, whilst the redoubt kept up a direct fire in their front. It must be observed, that when an oblique line is formed with the artillery, as at LE, it should be directed without the extremity of the enemy's flank, otherwise the guns would be exposed to be enfiladed.

Artillery should never fire against artillery, unless the enemy's troops are covered and his artillery exposed, or unless your troops suffer more from the fire of his guns, than his troops do from yours.

Never abandon your guns till the last extremity. The last discharges are the most destructive: they may perhaps be your salvation, and crown you with glory.

2nd. Artillery and Ammunition for a Siege.

Necessary considerations in forming an estimate for this service:—

The force, situation, and condition of the place to be besieged; whether it be susceptible of more than one attack;

tack; whether lines of circumvallation or countervallation will be necessary; whether it be situated upon a height, upon a rocky soil, upon good ground, or in a marsh; whether divided by a river, or in the neighbourhood of one; whether the river will admit of forming inundations; its size and depth; whether the place be near a wood, and whether that wood can supply stuff for fascines, gabions, &c.; whether it be situated near any other place where a depôt can be formed to supply stores for the siege. Each of these circumstances will make a very considerable difference in proportioning the stores, &c. for a siege. More artillery will be required for a place susceptible of two attacks, than for the place which only admits of one. For this last there must be fewer pieces of ordnance, but more ammunition for each piece. In case of lines being necessary, a great quantity of entrenching tools will be required, and a numerous field train of artillery. In case of being master of any garrison in the neighbourhood of the besieged town, and from whence supplies can readily be drawn, this must be regarded as a second park; and too great a quantity of stores need not be brought at once before the besieged place. The number of batteries to be opened before the place must determine the number of pieces of ordnance; and on the quantity of ordnance must depend the proportion of every species of stores for the service of the artillery.

There must be a battery to *enfilade* every face of the work

work to be besieged, that can in any way annoy the besiegers in their approaches. These batteries, at least that part of them to be allotted for guns, need not be much longer than the breadth of the rampart to be enfiladed, and will not therefore hold more than 5 or 6 heavy guns; which, with two more to enfilade the opposite branch of the covert-way, will give the number of guns for each ricochet battery.—As the breaching batteries, from their situation, effectually mask the fire of the first or ricochet batteries, the same artillery generally serves for both. Having thus ascertained the number of heavy guns, the rest of the ordnance will bear the following proportion to them:

Mortars.—From 8-inch to 13-inch, about one-third.

Small Mortars.—About one-fourth.

Heavy Howitzers.—About one-eighth.

The fewer natures of ordnance which compose the demand the better, as a great deal of the confusion may be prevented, which arises from various natures of ammunition and stores being brought together.

The Carriages for the Ordnance are generally as follows:

For 24-prs. six-fifths the number of guns.
For mortars, nine-eighths the number of mortars.
For howitzers, four-thirds the number of howitzers.
For *stone mortars*, seven-sixths the number of mortars.

Ammunition

Ammunition for the Ordnance.

24-prs.——At 1000 rounds per gun.

Mortars, howitzers, and stone mortars, at 800 rounds p piece of ordnance.

DURTUBIE.

The following proportion of artillery and ammunitio was demanded by a very able officer, for the intended sieg of Lisle, in 1794, which place was thought susceptible o two attacks:

64——24-prs. with carriages complete, at 50 *round sh* per gun, per day, for the whole siege; half o them *en ricochet*, with 2lbs. of powder; the oth half with the full charge of 8lbs.

Case and *grape* shot, at one round per gu per day, of each: 6lbs. per charge.

Shells for guns, two rounds ditto.

Flannel Cartridges, for the case, grape, and shell

Tin tubes, for the case and grape.

Quill tubes, for the round shot.

Spare, one-tenth.

28——10-inch mortars, on iron beds, at 50 shells eac per day, for the whole siege—3lbs. of powd charge—2lbs. 10oz. for bursting.

Pound-shot—100 to a charge—50 rounds p mortar each day, for 10 mortars 7 days; 2lbs. o powder each.

Ham

Hand-grenades—25 to a charge—the same as the pound-shot.

Carcasses, round—1 per mortar, per day.

8——8-inch howitzers, on travelling carriages.

30 *shells* for each per day, during the siege.

Case-shot—5 rounds per day each.

Carcasses—1 per day each.

Powder—1lb. per charge—1lb. 14oz. for bursting

20——$5\frac{1}{2}$-inch mortars, on wooden beds.

50 *shells* for each, per day, for the whole siege—charge 8oz.—12oz. for bursting.

Flannel cartridges, for one-eighth the number of rounds.

Tin tubes, in the same proportion.

Portfires, one-half the number of rounds, with tubes.

Fuzes, one-tenth to spare.

Match, 50 cwt.

Spare carriages for 24-prs. seven.

2 devil carriages.

6 sling carts.

6 block carriages.

3 forge carts.

3 store waggons, with iron and coals.

3 triangle gins, complete.

6 laboratory tents.

2 small petards.

4 grates for heating shot. *Table* 1.

TABLE I.

Return of Ordnance used at the Sieges of Ciudad Rodrigo and Badajos in 1812, *and St. Sebastian in* 1813.

	24-Pr. iron.	18-Pr. iron.	8-in. Howitr, brass.	68-Pr. Carrge iron.	5½-in. Howitr, iron.	10-in. mortar, iron.	Total of Pieces.
At Ciudad Rodrigo	34	4	..	..	..	..	38
Badajos, 1812	16	20	..	..	16	..	52
St. Sebastian, the first and second Sieges	48	6	13	8	..	20	95*

* At the first siege only twenty 24-prs. six 8-inch howitzers, four 68-pr. canonades, and four 10-inch mortars, were employed on the right; and, on the left, six 18-prs. At the second siege, on the right and left, 95 pieces of ordnance.

TABLE II.

Return of the Number of Rounds per Piece expended at the foregoing Sieges.

	24-Pr. & 5½ Howr.	18-Pounder.	8-in. Howitzer, and 68-pr. Carronades.	5½-Inch Howitzer.	10-Inch Mortar.
Ciudad Rodrigo ..	263	141	..	..	..
Badajos in 1812 ..	1249*	676	..	114	..
St. Sebastian, 1st and 2d Sieges	987	1575	474	..	188

* Much of this 24-pounder round shot was used by 24-pounder and 5½ inch howitzer in enfilade.

TABLE III.

and left, 95 pieces of ordnance.

enfilade.

TABLE III.

General Return of Ammunition expended at the foregoing Sieges.

	24-Pounders.				18-Pounders.				8-In. Howitzer^{s} & 68-Pr Carron^{s}			$5\frac{1}{2}$-In. Howit^{r}.					
	Round Shot.	Grape and Case.	Spherical Case.	Total 24-Pounder.	Round Shot.	Grape and Case.	Spherical Case.	Total 18-Pounder.	Common Shells.	Spherical Case.	Total 8-Inch Amm^{n}	Common Shells.	Spherical Case.	Total $5\frac{1}{2}$-Inch.	10-Inch Mortar.	Grand Total of Rounds.	Total Pounds of Powder.
Ciudad Rodrigo...	8950	..	..	8950	565	..	..	565	..	..	..	..	..	..	..	9515	182489
Badajos in 1812 ..	18832	1163	..	19995	13029	496	.	13525	..	..	..	507	1319	1826	..	35346	227070
St. Sebastian, 1st and 2d Sieges	43367	2094	1930	47391	9303	..	150	9453	7766	2198	9964	..	..	..	3755	70563	502110

Of the Arrangement of Artillery at a Siege.

The first arrangement of the artillery at a siege is to th different batteries raised near the first parallel, to enfilad the faces of the work on the front attacked, which fire o the approaches. If these first batteries be favourably situ ated, the artillery may be continued in them nearly th whole of the siege; and will save the erection of any oth gun batteries, till the besiegers arrive on the crest of th glacis. It, however, frequently happens, from local ci cumstances, that the besiegers cannot avail themselves the most advantageous situations for the first batteri There are four situations from which the defences of an face may be destroyed; but not from all with equal facilit The best position for the first batteries, is perpendicular t the prolongation of the face of the work to be enfilade If this position cannot be attained, the next that presen itself is on that side of the prolongation which takes th face in reverse; and under as small an angle as possible.- From both these positions the guns must fire *en ricoch* But if the ground, or other circumstance, will not adm of either of these being occupied by ricochet batteries, th battery to destroy the fire of a face must be without th prolongation, so as to fire obliquely upon the outside the face. The last position, in point of advantage, is di rectly parallel to the face.—From these two last positio the guns must fire with the full charges.

Th

The second, or breaching batteries at a siege, are generally placed on the crest of the glacis, within 15 or 18 feet of the covert way; which space serves as the epaulment; but if the foot of the revetement cannot be seen from this situation, they must be placed in the covert-way, within 15 feet of the counterscarpe of the ditch. These batteries must be sunk as low as the soles of the embrazures, and are in fact but an enlargement of the sap, run for the lodgment on the glacis or in the covert way. In constructing a battery on the crest of the glacis, attention must be paid that none of the embrazures open upon the traverses of the covert-way. These batteries should consist of at least four guns; and if the breadth between the traverses will not admit of this number, at the usual distances, the guns must be closed to 15 or 12 feet from each other.

The mortars are generally at first arranged in battery, adjoining the first gun batteries, or upon the prolongation of the capitals of the works; in which place they are certainly least exposed. Upon the establishment of the half parallels, batteries of howitzers may be formed in their extremities, to enfilade the branches of the covert-way; and upon the formation of the third parallel, batteries of howitzers and stone mortars may be formed to enfilade the flanks of the bastions, and annoy the besieged in the covert-way. In the lodgement on the glacis, stone and other mortars may also be placed, to drive the besieged from their defences. A great object in the establishment of all

these

these batteries is to make such an arrangement of them that they mask the fire of each other as little as possible, and particularly of the first, or ricochet batteries. This may very well be prevented till the establishment on the crest of the glacis, when it becomes in some degree unavoidable: however, even the operations on the glacis may be so arranged, that the ricochet batteries be not masked till the breaching batteries be in a great state of forwardness: a very secure method, and which prevents the soldiers in trenches being alarmed by the shot passing over their heads, is to raise a *parados*, or parapet, in the rear of the trenches, at such parts where the fire from the besiegers' batteries crosses them.—For further details on this subject, and for the manner of constructing batteries, see the word *Battery:* also the words *Ricochet, Breach, Magazine, Platform.*

3d. *Artillery and Ammunition for the Defence of a Fortified Place.**

It is usual in an Estimate of Artillery and Ammunition for the Defence of Fortified Places, to divide them into Eight Classes, as follows:

CLASSES.	1	2	3	4	5	6	7	8
Garrisons	12000	10000	8000	5000	3500	2500	1600	400
Cannon	100	90	80	70	60	50	40	30
Triangle Gins	4	3	2	2	2	1	1	1
Sling Carts...........	4	3	2	2	2	1	1	1
Jacks, of sizes..........	4	3	2	2	2	1	1	1
Truck Carriages........	6	6	4	4	2	2	2	2
Ammunition Carts, &c...	12	12	12	6	6	6	2	2
Tools for Pioneers	9000	6000	5000	4000	3500	3000	1000	1000
—— Miners	300	200	100	100	100	100	50	50
Tools for cutting { 1/3 Axes ..... 2/3 Bill-hooks }	1200	900	600	500	450	300	150	150
Forges, complete	6	4	2	2	2	2	1	1

* The *Aide Memoire* lays down as a general rule, that, 4,200 infantry are necessary for a hexagon susceptible of one attack only, and that an addition of 150 men per front should be added for every side above six of the polygon.

The guns will be of the following calibers: one-third 18-prs—one-third of 12-prs—and one third of 24, 9, [and] 6-prs, in equal proportions. If the place does not possess any very extraordinary means of defence, it will be very respectably supplied with 800 rounds of ammunition per gun for the two larger calibers, and 900 for each of the others.

Gun Carriages—One-third more than the number of guns.

Mortars—About one-fourth the number of guns in the three first classes; and one-fifth or one-sixth in the other classes.—Of these two-fifths will be 13 or 10-inch mortars, and the rest of a smaller nature.

Howitzers—One-fourth the number of mortars.

Stone-Mortars—One-tenth the number of guns.

Shells—400 for each of the 10 and 13-inch mortars, and 600 for each of the smaller ones.

Beds for mortars—one-third to spare.

Carriages for howitzers—one-third to spare.

Hand-Grenades—4 or 5000 for the two first classes; 2000 in the three following classes; and from 1500 to 600 in the three last classes.

Rampart Grenades—2000 for the first class; 1000 for the four following classes; and 500 for the sixth class; none for the two last.

Fuzes—One-fourth more than the number of shells.

Botto[m]

Bottoms of wood for stone mortars—400 per mortar.

Sand Bags—500 for every piece of ordnance in the large places, and one-fourth less in the small ones.

Handspikes—10 per piece.

Tackle-falls for gins—1 for every 10 pieces to spare.

Musquets—1 per soldier, and the same number to spare.

Pistols, pairs—One-half the number of musquets.

Flints—50 per musquet, and 10 per pistol.

Lead or *Balls* for small arms—30 pounds per musquet.

Powder for small arms—5 pounds for every musquet in the garrison, including the spare ones.

The above proportions are taken from *Durtubie's Manuel de l'Artilleur*.

The following method of regulating the management of the artillery, and estimating the probable expenditure of ammunition in the defence of a fortified place, is extracted from a valuable work on fortification, lately published at Berlin. It is particularly applied to a regular hexagon; the siege is divided into three periods, viz.

1*st*. From the first investiture to the first opening of the trenches, about 5 days.

2*nd*. From the opening of the trenches to the effecting a lodgement on the glacis, about 18 days.

3*rd*. From this time to the capitulation, about 5 days.

First Period. Three guns on the barbette of each bastion and on the barbettes of the ravelins in front of the gate-

ways,

ways, half 24-prs. and half 18-prs.* three 9-prs. on t barbette of each of the other ravelins.

Twelve 12-prs. and twelve 6-prs. in reserve.

One 13-inch mortar in each bastion.

Six of 8-inch in the salient angles of the covert-way.

Ditto in reserve.

Ten stone mortars.

The 12-prs. in reserve, are to be ranged behind t curtain, on whichever side they may be required, and t 6-prs. in the outworks; all to fire *en ricochet* over t parapet. By this arrangement, the whole of the barbe guns are ready to act in any direction, till the side attack is determined on; and with the addition of the r serve, 49 pieces may be opened upon the enemy the ve first night they begin to work upon the trenches.

The day succeeding the night on which the trenches a opened, and the side to be attacked determined, a ne arrangement of the artillery must take place. All the and 18-prs. must be removed to the front attacked, a the other bastions, if required, supplied with 12-prs. T barbettes of the bastions on this front may have each guns, and the twelve 18-prs. may be ranged behind t curta

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* Note—for 16-prs. in the French work, the compi has said 18-prs.—for 8-prs. 9 prs.—for 4-prs. 6-prs.— 12-inch mortars, 13-inch : to which they nearly answe

curtain. The six mortars in reserve must be placed, two in each of the salient angles of the covert-way of this front, and with those already there, mounted as howitzers,* to fire down the prolongations of the capitals. Three 6-prs. in each of the salient places of arms of the ravelines, on the attacked fronts, to fire over the palisading, and five 9-prs. in the ravelin of this front. This arrangement will bring 47 guns and 18 mortars to fire on the approaches after the first night; and with a few variations will be the disposition of the artillery for the second period of the siege. As soon as the enemy's batteries are fairly established, it will be no longer safe to continue the guns *en barbette*, but embrazures† must be opened for them; which embrazures must be occasionally masked, and the guns assume new directions, as the enemy's fire grows destructive; but may again be taken advantage of, as circumstances offer. As the enemy gets near the third parallel, the artillery must be withdrawn from the covert-way to the

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* Note—Our iron mortars, on iron beds, all admit of being fired at low angles.

† Note—A German author proposes that the mounds of earth which enable the guns to fire *en barbette*, should be so arranged, that the embrazures may be opened between them; and when the guns descend to the embrazures, the barbettes will serve as traverses.

the ravelins, or to the ditch, if dry, or other favourable situations; and, by degrees as the enemy advances, to the body of the place.—During this period of the siege, the embrazures must be prepared in the flanks, in the curtain which joins them, and in the faces of the bastions which flank the ditch of the front ravelins.—These embrazures must be all ready to open, and the heavy artillery mounted in them, the moment the enemy attempts a lodgment on the glacis.

Every effort should be made to take advantage of the favourable moment, when the enemy, by their own works must mask their former batteries, and before they are able to open their new ones.

The expenditure of ammunition will be nearly as follows:

First period of the siege—5 rounds per gun per day, with only half the full charge, or one-sixth the weight of the shot, and for only such guns as can act.

Second period—20 rounds per gun per day, with one-sixth the weight of the shot.

Third period—60 rounds per gun per day, with the full charge, or one-third the weight of the shot.

Mortars—At 20 shells per day, from the first opening of the trenches to the capitulation.

Stone Mortars—80 rounds per mortar for every 24 hours

from the establishment of the demi-parallels to the capitulation—about 13 days.

Light, and Fire Balls—Five every night for each mortar, from the opening of the trenches to the eighth day, and three from that time to the end of the siege.

These amount to about 700 for guns.
400 for mortars.
1000 for stone ditto.

This proportion and arrangement is however made upon a supposition, that the place has no countermines to retard the progress of the besiegers, to a period beyond what is above mentioned; but the same author estimates, that a similar place, with the covert-way properly countermined before-hand, and those countermines properly disputed, may retard a siege at least two months; and that if the other works be likewise effectually countermined and defended, the siege may be still prolonged another month.

The above proportion is therefore to be further regulated, as the strength of the place is increased by these or any other means.—These considerations should likewise be attended to, in the formation of an estimate of ammunition and stores for the siege of a fortified place.—See *Carriage, Platform, Park*, and the different natures of artillery, as *Gun, Mortar, Howitzer*, &c.

The small-arms ammunition is estimated by this author as follows:

$\frac{1}{4}$ of

¼ of a pound of gun-powder, or 10 rounds per day p
man, for all the ordinary guards.

1¼ lb. or 50 rounds per man per 12 hours, for all extr
ordinary guards.

⅝ of a pound, or 25 rounds for every man on pick
during the period of his duty.

In addition to the foregoing article, the following be
more detailed, has been translated and extracted from
work on fortification, published in Paris, 1811, by C
Noizet Saint Paul, of the French engineers:

Arrangement of artillery for the defence of a fortre
during a siege.—

The first object to be attended to, when it is ascertain
that the enemy's troops are in motion towards the plac
(presuming that it is amply supplied with provisions, am
munition, and stores, and that every precaution has be
taken to collect from the vicinity what might fall into th
enemy's hands) is to establish the barbette batteries in th
salient angles, and to place a proportion of guns in th
covert-way and out-works. If the body of the place h
cavaliers, the heaviest guns should be placed on the
Strong guards must be mounted on the gates; and if th
commandant has reason to suspect the fidelity of the in
habitants, guards must be distributed about the town, an
an interior police formed. A stop must be put to t
exterior works carrying on, and no person must be a
lowed to come in or go out. If the surrounding countr

can be inundated, it must be taken advantage of, and the roads, causeways, and dykes, must be broken up. Patroles of cavalry, supported by small detachments of infantry, posted in advantageous situations, must be sent out; the cavalry must be pushed on as far as possible, without danger of being cut off, and their retreat should be protected by the posts of infantry. If the place has a strong garrison, permanent posts must be established on the principal avenues, in order to hinder the enemy as long as possible from establishing himself near the place. As the enemy advances the cavalry must be withdrawn.

One-third of the artillery-men must be stationed in the barbettes, cavaliers, and outworks; and permanent detachments, consisting of a third of the infantry, stationed in the covert-way and ravelins.

In the first moments of the investment, the artillery of the place should not endeavour, by a useless fire (which only shews to the enemy the range of their guns) to disturb them. It is, nevertheless, necessary to have some guns loaded with half the charge, to protect the retreat of the advanced posts, and to mislead the enemy with respect to the range of their guns. It is only when the besiegers are making permanent dispositions for their establishment, that the artillery of the place should be made use of, by cannonading briskly such posts as are within reach. This is also the moment, if the garrison is numerous and composed of good troops, to annoy the besiegers by sorties, on

different

different points of the line of contravallation, and to ret the works necessary for establishing their communi tions; care must, however, be taken not to purchase th advantage by a loss of men and artillery, which would i fluence the defence of the place.

When the investment is completed, and the enemy she his intention of undertaking the siege, all the batteries a outworks of the place must be furnished with ammuniti and the necessary equipments. Mortars loaded with shel and fire balls, are to be placed in different points of th body of the place, and the artillery in reserve got ready t move to where it may be wanted; the guards in the cover way and outworks must be completed, and reserves draw from the second third of the garrison stationed in the i terior, so as to be able to march to the points they may b required.

If the besiegers should drive in all the advanced po of the garrison, patroles formed from the guards of th covert-way, must supply the place of them during th nights which precede the opening of the trenches; a night-fall, these patroles, supported by small detachme of cavalry, should advance by echellons, as far as possib without the risk of being cut off. Thus, it will be diffic for the besiegers to conceal the opening of the trench and the reconnoissanses of their engineers. As the troo of the besiegers, charged with the defence of the opening

t

the trenches, advance, these patroles should fire on them, and retreat to the covert-way.

As soon as the side of attack is determined, the artillery in reserve must be brought to the barbettes on that front, and some fire-balls thrown from the mortars, by which the enemy's movements may be discovered, and the fire of the garrison directed, which must be kept up briskly during the first hours. The guns and howitzers must fire *en ricochet*, and the mortars throw shells and fire-balls. A few chosen men should be armed with wall-pieces in the outworks, which they must direct on the parties endeavouring to extinguish the fire-balls, by putting earth over them.

The side which is not attacked must not be in part disarmed until the determination of the enemy is known, for having drawn the attention of the besieged to one point, he may suddenly fall on one another: when this is fixed, part of the artillery from the fronts unattacked may be withdrawn, in order to strengthen those which are.

If the garrison is numerous, and the ground favourable for a retreat, the commandant may try a grand sortie; but if, on the contrary, it is weak, and the localities do not offer an advantage, it must not be undertaken, especially if the besiegers are strong in cavalry.

Disposition of the artillery of a fortress besieged. Let us suppose, for example, that the fortress is a regular hexagon, and that the bastions of the front of attack are num-

 bered

bered from the right. No. 1, half bastion; No. 2, right bastion; No. 3, left bastion; No. 4, half bastion; No. 5, right ravelin; No. 6, centre ravelin; No. 7, left ravelin. Let us also suppose that the fortress contains 40 pieces of cannon of different natures, 6 howitzers, 4 large mortars, and 4 stone mortars.

On the left face of No. 1, *en barbette*	3
On the capital of No. 2, one; and on each face close to it, one; all *en barbette*	3
No. 3, the same..........................	3
On the right face of No. 4, *en barbette*	3
Ravelin, No. 5, left face, *en barbette*	2
Ravelin, No. 6, in the salient angle, *en barbette*..	2
Ravelin, No 7, placed the same	2
On the curtains and reserve, which fire *en ricochet* over the parapet	10
Total..	28

The 6 howitzers behind the faces of the bastions in readiness to move when required.

The mortars, one in each of the four bastions; 3 of them to throw light-balls during the night, where the besiegers are opening their trenches and 1st parallel: shells are only to be thrown where masses of the enemy appear. The fire of the batteries should be directed, during the day, on such parts of the parallel as are unfinished, and on the points of the capitals where the zig-zags depart. When th

the enemy's attacks are determined on, the besieged may reinforce the artillery on that front by withdrawing, suppose 8 pieces, from the side unattacked; a new disposition will then be required.

On the left face of No. 1, *en barbette*	3
On the faces of capital of No. 2, *ditto*	5
Ditto ——————— No. 3, *ditto*	5
On the right face and capital of No. 4, *ditto*	4
Ravelin, No. 5, left face, *ditto*	3
Ravelin, No. 6, *ditto*	5
Ravelin, No. 7, *ditto*	5
Salient places of arms of 5 and 7, 3 each of the lightest calibre	6
Total..	36

The 6 howitzers in the salient places of arms in front of bastions 2 and 3, and of the ravelin 6. The guns and howitzers in the salient places of arms are destined to keep up a crossed and ricochet fire on the capitals of the zig-zags, and must be placed as near as possible to the salient angles, in order to be the less exposed to be taken in reverse by the batteries of attack.

As soon as the besiegers commence the construction of their first batteries, all the fire of the place must be directed to those points, and the mortars which had previously fired at low angles, must now fire with greater elevation, though at all times sparingly. The guns *en*

barbette must now be covered by merlons, and the situation of the guns altered whilst this work is carrying on; as by frequently doing so, the enemy will be obliged also to change his dispositions of attack.

The situations most proper for the new dispositions are on the three curtains of the front attacked; on the centre curtain, behind ravelin 6, place 8 pieces, the embrasures cut obliquely towards the centre; and on each of the others, 4. These batteries, which are less exposed to the fire of the enemy's first batteries, see very well the works of the demi-parallels or places of arms, and take in escarp a part of the zig-zag communications on the capitals of the bastions. This disposition leaves the faces of the bastions free for the occupation of the infantry, whose fire will soon be required. The guns en barbette in the centre ravelin 6, must be withdrawn as soon as the enemy's batteries are in full activity, and their place supplied by infantry; as from the salient position of this ravelin, it will be the object of the besieged not to draw the enemy's fire on it, and to preserve it in a good state as long as possible. The guns on the curtains must be supplied from the barbettes, as soon as the besiegers' batteries are ready to open. When, by reason of the enemy's fire, the barbettes become altogether untenable, the light guns, not required for the curtains, may be ranged along the faces and flanks, and fire en ricochet over the parapet. These guns, together with those on the curtains, will have great effect until the besiegers

siegers have changed the direction of their fire, which before was directed against the barbettes.

If the besiegers should open their first batteries successively, advantage may be taken of it, and the whole of the fire of the garrison directed on each as it opens. When the enemy debouches from the first parallel, the fire of guns and mortars must, night and day, be directed on the zig-zags of communication.

When the enemy commences his second parallel, the fire must be spread over all parts of the line of operations; and although the range may be great for musquetry, it may be directed with care and effect from the branches of the covert-way, so as to annoy the besiegers. At this epoque of the siege, the guns in the ravelins may be brought into the body of the place, for it is hardly to be expected that they will be able to maintain their stations after the enemy's batteries are in full force. Partial attacks by the sorties of small detachments from the covert-way, should now be carried on during the night, in order to impede the besiegers' progress.

When the approaches are carried on from the second parallel, and the enemy about to establish the demi-places of arms, the fire of the garrison must be multiplied as much as possible, and all the activity possible given to it. During the night, the banquets of the body of the place, covert-way, &c. must be manned by infantry, and an incessant fire of musquetry kept up; for this is the time

when

when the besiegers undertake those works, which it would be dangerous to do in the day time, and take less precautions to cover themselves. A grand sortie may now be tried, if the garrison is numerous: day-break is the best time, for then the workmen of the besiegers are fatigued, whilst those of the garrison, taken from the third of its complement which have been at rest, are fresh. An hour before day-light, the infantry are assembled in the covert-way of the front attacked, the artillery with field pieces, and the cavalry in the covert-way of the collateral fronts, right and left, where they wait without noise for the signal.

The fire of the garrison during the night must be kept up with increased activity. On the departure of the sortie, the direction of the fire must be changed to those points from which the besiegers might expect reinforcements, particularly on the wings of the sortie.

At the appointed signal, the columns of infantry, followed by workmen with their tools, march out by the barriers in the re-entering places of arms and branches of the covert-way. Arrived at the enemy's works, they are to overthrow all they encounter of the enemy's troops, and take post by divisions in front, whilst the detachments of workmen, directed by engineers, fill up the trenches, destroy the materials, tools, batteries, gun-carriages, and platforms; other parties, conducted by artillery officers, spike the guns, and assist in destroying the carriages; and,

lastly,

lastly, a third section must be employed in carrying off, within the garrison, all the arms, ammunition, and materials possible. Success, however, must not induce the troops to advance too far.

The cavalry and field artillery, supported by detachments of infantry, must protect the wings of the sortie. The object of a sortie being to destroy the enemy's works, as soon as this is completed, a retreat must be ordered; and as the taking of prisoners would only encumber the besieged, it must be avoided. The retreat must be covered by some pieces of light artillery, placed on the salient angles *en barbette*, and by the infantry posted in the covert-way.

If the localities of the place will permit, counter-approaches may be carried on to a short distance, in order to flank the besiegers. This can only be done when the flanks of the counter-approaches can be well appuyed, and not subject to be turned, and at the time the besiegers gain the foot of the glacis.

When the enemy's ricochet batteries enfilade the branches of the covert-way, the howitzers placed there must be withdrawn to the body of the place, and disposed 2 in each flank of the half bastions on the right and left, 2 in the left face of No. 2, and 2 in the right face of No. 3, and fire en ricochet on the capitals of the approaches.

The stone mortars supply the place of the howitzers in the salients of the covert-way, and may now be brought into

into action. These pieces offer less surface to be taken in reverse, and have great effect.

The light guns in the covert-way must remain as long as possible, perhaps till the establishment of the third parallel.

When the besiegers have aporoached to the foot of the glacis, and are commencing their third parallel, it will be found that the artillery on the terre-pleine of the body of the place will not be able to see the whole of the works of the parallel, unless the ramparts have a greater relief than is usually given to them; it will therefore be necessary to endeavour to establish the light guns on the barbettes which had been withdrawn. This must be done as rapidly as possible, in order to surprise the besiegers with the fire of those batteries which they had considered as dismounted. These guns must be maintained as long as possible, and when forced to abandon their situations, must re-appear again at intervals. If the bastions have cavaliers, they must be remounted in the same manner, and the artillerymen covered in the embrasures by musquet proof blinds. The fire of the barbettes must be supported by that of the howitzers and stone mortars from the salients of the bastions and centre ravelin, No. 6, when the fire of the enemy's musquetry has obliged these pieces to withdraw from the covert-way, and also by the infantry of the garrison stationed in the outworks.

When the enemy has gained the crest of the glacis, and is

is about to establish his breaching batteries and counter-batteries against the flanks, a new disposition of artillery will be requisite. Of the original 36 disposable pieces, 6 may be presumed to be dismounted or rendered unserviceable; if not, they may be kept as a reserve, to run up occasionally to the barbettes, as the fire of the besiegers will admit of: 16 of the heaviest calibre are to be placed on the flanks of the bastions, in such a manner as to command the salient angles of the bastions 2 and 3: eight others on the curtain between these two bastions, in an oblique situation, so that their fire may be directed to the same spot: 3 others on the left face of bastion 2, and 3 on the right face of bastion 3, which will command the ditch and salient angle of the centre ravelin, No. 6. The flanks and faces must have traverses constructed on the terre-pleine, in order to protect the guns as long as possible. The howitzers may be placed on such parts of the curtain as are not occupied with the guns, and should fire *en ricochet* on the capitals of the approaches. Both mortars and stone mortars, loaded with stones, small balls, or langrage, must endeavour to cover the crest of the glacis with their fire at high angles. If the glacis should be mined, the besieged must get every thing in readiness to spring them, and to establish a subterraneous defence, to dispute the galleries with the besiegers. Should the besiegers advance from the third parallel to the crest of the glacis by sap, sorties must be carried on from the re-entering and salient places of arms,

arms, during the night, against the heads and flanks of the sap; and, during the day, the guns on the barbettes employed against the heads of them.

If, on the contrary, the besiegers endeavour to carry the covert-way, and to establish themselves by open force, strong parties must be stationed in the re-entering and salient places of arms, and the banquets of the ravelin 6, and body of the place manned, to protect them, whilst the fire of the guns must be directed on the debouches of the third parallel, and that of the howitzers on the approaches. Under cover of the night, infantry may be placed on the top of the parapet, here and there one, so as to plunge their fire into the enemy's works.

When the enemy having established their breaching batteries, and are occupied in the descent and passage of the ditch, if it should be a wet one, and a current of water can be introduced into it, it would then be advantageous so to do; or, if not, armed boats and rafts may be employed.

If a dry ditch, sorties must be carried on against the enemy's works, from the sally-ports in the flanks, and be assembled behind the tenaille of the curtain. Lastly, if the ditch can be made wet or dry at pleasure, the time to let in the water is, when the passages of the besiegers touch the foot of the breach.

If, notwithstanding all these efforts, the besiegers have made good the passage of the ditch, and the garrison is weak,

weak, and the bastions not having been found capable of being retrenched, this is the moment to capitulate. But if, on the contrary, the garrison is strong, and the commandment determined to sustain the assault, the flanks and curtain of the front attacked must be repaired, and put into the best possible state of defence. Loaded shells, hand-grenades, tarred faggots, &c. must be placed under cover in the ramparts of the bastions, to be made use of when required, and as near to the breaches as possible; also materials of every sort capable of embarrassing the passage of the breaches, such as carriages, cheveaux de frize, large boughs of trees, &c. in readiness to bring forward at the moment the enemy's fire on the breach ceases. Previous to the assault being given, parties of workmen, directed by engineers, must be stationed for this purpose in the bastions behind the faces; two field pieces, loaded with case shot, must be in readiness on the ramps, to run up so as to command the breach; the ramps must be put in the best possible state, and others made to facilitate the retreat of the troops charged with the defence of the breach, and cheveaux de frize ready to block them up if required; such of the habitations as command them must be strengthened, and troops stationed in them. Erect traverses; blockade the houses; and cut ditches in the streets; establish a central rendezvous; fortify it, if possible; withdraw all useless pieces of artillery, ammunition, &c. from the ramparts into it; station the infantry to defend the breaches,

breaches, in columns, along the faces, flanks, and curtains attacked; and dispose the remainder of the troops in echellons from the ramparts to the central rendezvous or redoubt; attack the enemy when mounting the breach, if possible, in flank, by a sally from behind the tenaille, if a dry ditch, and the guns on the flanks are dismounted; reinforce the guards on the gates; the artillery-men in the flanks must spike their guns, and blow up their ammunition, when the troops, charged with the defence of the breach, are obliged to retreat; the besieged must not endeavour to cover the breaches with obstacles, until the enemy are in the act of mounting them; for the whole of the enemy's batteries being directed on these points, would soon destroy them; fougasses should be laid the night preceding in the breach; passages must be left at the ends of the barrier formed behind the breach, and cheveaux de frize ready to stop them up. The position from whence the commandant should observe all the movements, is behind the centre of the curtain of the front of attack. If the enemy should succeed in forcing the breaches and barriers, the houses must be occupied and defended till the last extremity; or, if the necessary precautions have not been taken for that purpose, the garrison must retreat to the central rendezvous, and there capitulate.

If the bastions should have been retrenched previous to, or during the siege, the same means must be adopted to defend them as stated for the breach; which latter cannot

be

be defended with so many troops, owing to the small space unoccupied in front of the retrenchment. If this space is not mined, fougasses must be laid in it. Perhaps it might be adviseable to try a grand sortie at the moment the enemy mounts the breaches.

NOIZET ST. PAUL.

AXLE TREES.—See *Carriages.*

BAR

BALLS—of lead of different natures.

Nature.	Number to one Pound.	Diameter in Inches.	Number made from one Ton of Lead.
Wall pieces	$6\frac{3}{4}$	·89	14,760
Musquets........	$14\frac{1}{2}$	·68	32,480
Carbines	20	·60	44,800
Pistols	34	·51	78,048
7 Barrel Guns	$46\frac{1}{2}$	·46	104,160

Lead Balls are packed in boxes containing each one cwt. About four pounds of lead in the cwt. are generally lost in casting. See *Shot.*

BARRELS for Powder—Their dimensions.

	Whole Barrels.		Half Barrels.		Quarter Barrels.	
	Ft.	In.	Ft.	In.	Ft.	In.
Depth	1	9·61	1	5·13	1	2·25
Diameter at top	1	3·61	1	0·37		9·35
——— at bulge	1	5·36	1	2·		10·71
——— at bottom	1	3·51	1	0·31		9·41

The

The whole barrels are made to contain 100 pounds, and the half barrels 50 pounds of powder; but of late only 90 pounds have been put into the barrels, and 45 into the half barrels; which, by leaving the powder room to be shifted, preserves it the better.

Budge Barrels contain 38lbs.

Weight of barrel—copper hooped—10lbs.	
——— hazle hooped— 6lbs.	
Length of barrel	$10\frac{1}{2}$ inches.
Diameter	1 foot 1 inch.

BASKETS.—Ballast, $\frac{1}{2}$ bushel—weight 5lbs. Diameter, 1 foot 6 inches—length, 1 foot.

BATTERY.—Dimensions of Batteries.

1. *Gun Batteries.*—Gun Batteries are usually 18 feet per gun. Their principal dimensions are as follow:

Ditch.—Breadth	12 feet.
Depth	8

Note.—These dimensions give for a battery of two guns 3456 cubic feet of earth; and must be varied according to the quantity required for the epaulment.

Epaulment.—Breadth at bottom	23 feet
——— at top	18
Height within	7
——— without	6 ft. 4 in.
Slope, interior	$\frac{2}{7}$ of height.
——— exterior	$\frac{1}{2}$ of height.

Note.—The above breadths at top and bottom are for the

the worst soil; good earth will not require a base of more than 20 feet wide, which will reduce the breadth at top to 15 feet; an epaulment of these dimensions for two guns will require about 4200 cubic feet of earth, and deducting 300 cubic feet for each embrazure, leaves 3600 required for the epaulment. In confined situations the breadth of the epaulment may be only 12 feet.

Embrazures.—Distance between their centres	18 feet.
Openings, interior	20 inches.
——— exterior	9 feet.
Height of the sole above the platform	32 inches.

Note.—Where the epaulment is made of a reduced breadth, the openings of the embrazures are made with the usual breadth within, but the exterior openings proportionally less. The embrazures are sometimes only 12 feet asunder, or even less when the ground is very confined. The superior slope of the epaulment need be very little, where it is not to be defended by small arms. The slope of the sole of the embrazures must depend upon the height of the object to be fired at. The *Berm* is usually made 3 feet wide, and where the soil is loose, this breadth is increased to 4 feet.

2. *Howitzer Batteries.*—The dimensions of howitzer batteries are the same as those for guns, except that the interior openings of the embrazures are 2 feet 6 inches, and the soles of the embrazures have a slope inwards of about 10 degrees.

3. *Mortar*

3. *Mortar Batteries*—Are also made of the same dimensions as gun batteries, but an exact adherence to those dimensions is not so necessary.—They have no embrazures. The mortars are commonly placed 15 feet from each other, and about 12 feet from the epaulment.

Note.—Though it has been generally customary to fix mortars at 45°, and to place them at the distance of 12 feet from the epaulment, yet many advantages would often arise from firing them at lower angles; and which may be done by removing them to a greater distance from the epaulment, but where they would be in equal security. If the mortars were placed at the undermentioned distances from the epaulment, they might be fired at the angles corresponding:

At 13 feet distance for firing at 30 degrees.
21........................ 20
30........................ 15
40........................ 10

over an epaulment of 8 feet high.

A French author asserts, that all ricochet batteries, whether for howitzers or guns, might be made after this principle, without the inconvenience of embrazures; and the superior slope of the epaulment being inwards instead of outwards, would greatly facilitate this mode of firing.

If the situation will admit of the battery being sunk, even as low as the soles of the embrazures, a great deal of labour may be saved. In batteries without embrazures this

this method may almost always be adopted; and it becomes in some situations absolutely necessary, in order to obtain earth for the epaulment; for when a battery is to be formed on the crest of the glacis, or on the edge of the counterscarp of the ditch, there can be no excavation but in the rear of the battery.

4. *Batteries on a Coast*—Generally consist of only an epaulment, without much attention being paid to the ditch: they are however sometimes made with embrazures, like a common gun-battery; but the guns are more generally mounted on traversing platforms, and fire over the epaulment. When this is the case, the guns can seldom be placed nearer than $3\frac{1}{2}$ fathoms from each other. The generality of military writers prefer low situations for coast batteries; but M. Gribauvale lays down some rules for the heights of coast-batteries, which place them in such security, as to enable them to produce their greatest effect.—He says the height of a battery of this kind, above the level of the sea, must depend upon the distance of the principal objects it has to protect or annoy. The shot from a battery to ricochet, with effect, should strike the water at an angle of about 4 or 5 degrees at the distance of 200 yards.—Therefore the distance of the object must be the radius, and the height of the battery the tangent to this angle of 4 or 5 degrees; which will be, at the above distance of 200 yards, about 14 yards.—At this height, he says, a battery may richochet vessels in perfect security; for their ricochet

being

being only from a height of 4 or 5 yards, can have no effect against the battery. The ground in front of a battery should be cut in steps, more effectually to destroy the ricochet of the enemy. In case a ship can approach the battery so as to fire musquetry from her tops, a few light pieces placed higher up on the bank, will soon dislodge the men from that position, by a few discharges of case shot. It is also easy to keep vessels at a distance by carcasses, or other fire-balls, which they are always in dread of.

Durtubie estimates, that a battery of 4 or 5 guns well posted, will be a match for a first rate man of war.

To estimate the Materials for a Battery.

Fascines of 9 feet long are the most convenient for forming a battery, because they are easily carried, and they answer to most parts of the battery without cutting.—The embrazures are however better lined with fascines of 18 feet.—The following will be nearly the number required for a fascine battery of two guns or howitzers.

90 fascines of 9 feet long.

24 fascines of 18 feet—for the embrazures.

This number will face the outside as well as the inside of the epaulment, which, if the earth be stiff, will not always be necessary; at least not higher than the soles of the embrazures on the outside.—This will require five of 9 feet for each merlon less than the above.

A mortar battery will not require any long fascines for the

the lining of the embrazures. The simplest method of ascertaining the number of fascines for a mortar battery, or for any other plain breast-work, is to divide the length of work to be fascined in feet, by the length of each fascine in feet, for the number required for one layer, which being multiplied by the number of layers required, will of course give the number of fascines for facing the whole surface. If a battery be so exposed as to require a shoulder to cover it in flank, about 50 fascines of 9 feet each will be required for each shoulder.

Each fascine of 18 feet will require 7 pickets.

——————— 9 feet ——————— 4 ditto.

12 workmen of the line, and 38 of the artillery, are generally allotted to each gun.*

If to the above proportion of materials, &c. for a battery of two guns, there be added for each additional gun, 30 fascines of 9 feet, and 10 of 18 feet, with 12 workmen, the

* Thirty-eight artillery-men will be unnecessary if the fascines are made before-hand, which ought always to be the case; the gun detachment of eight to a 24-pounder and 42 of the line, wjll be sufficient until the platforms are to be laid; and the thirty artillery-men, whose duties are constant and fatiguing, may be spared till the battery is in a state of forwardness, when they may relieve the same proportion of the line.

the quantity may easily be found for a battery of any number of pieces.

The workmen are generally thus disposed:—½ the men of the line in the ditch, at 3 feet asunder, who throw the earth upon the berm; ¼ upon the berm, at 2 feet asunder, to throw the earth upon the epaulment; and the other ¼ upon the epaulment, to level the earth, and beat it down. —The artillery-men carry on the fascine work, and level the interior of the platforms. This number of workmen may complete a battery in 36 hours, allowing 216 cubic feet to be dug and thrown up by each man *in the ditch* in 24 hours.

Tools for the construction of a Battery.

Entrenching.—1½ times the number of workmen required; half to be pick-axes, and half shovels or spades, according to the soil.

Mallets—3 per gun.

Earth Rammers—3 per gun.

Cross-cut Saws—1 to every two guns.

Hand-bills or *Hatchets*—2 per gun.

This estimate of tools and workmen does not include what may be required for making up the fascines, or preparing the other materials, but supposes them ready prepared.—For these articles, see the words *Fascine, Gabion, Platform, &c.* and for the construction of field magazines for batteries, see the word *Magazine.*

Note.

Note. The following estimate of the quantity of earth which may be removed by a certain number of workmen in a given time, may serve to give some idea of the time required to raise any kind of works: 500 common wheel-barrows will contain 2 cubic toises of earth, and may be wheeled by one man, in summer, to the distance of 20 yards up a ramp, and 30 on a horizontal plain, in one day. —In doing which he will pass over, going and returning, about 4 leagues in the first case, and 6 in the last. Most men, however, will not wheel more than $1\frac{3}{4}$ toise per day. —Four men will remove the same quantity to four times the distance.

In a soil easy to be dug, one man can fill the 500 barrows in a day; but if the ground be hard, the number of fillers must be augmented, so as to keep pace with the wheel-barrow man.

TABLE

TABLE

*Of the Workmen, Materials, and Tools for constructing Batteries.**

N° of Guns.	Fascines of 9 feet.	Fascines of 18 feet.	Pickets.	Workmen, includ-ing Artillery-men.	Pick-axes.	Shovels or Spades, or ½ of each.	Mallets.	Earth Rammers.	Cross cut Saws.	Hind-bills or Hatchets.
2	90	24	520	50	37	38	6	6	1	4
3	120	34	718	62	46	47	9	9	2	6
4	150	44	908	74	55	56	12	12	2	8
5	180	54	1080	86	64	65	15	15	3	10
6	210	64	1288	98	73	74	18	18	3	12
7	240	74	1478	110	82	83	21	21	4	14
8	270	84	1688	122	91	92	24	24	4	16
9	300	94	1858	134	100	101	27	27	5	18
10	330	104	2048	146	109	110	30	30	5	20
11	360	114	2238	158	118	119	33	33	6	22
12	390	124	2420	170	127	128	36	36	6	24

* Flanks not included.

Battery of Field Pieces, (or Brigade as it was denominated during the last war,) usually consisted of six pieces of ordnance, including one howitzer: to these were attached

tached six ammunition carriages with limbers, a forge waggon, a wheel carriage, two store limber waggons, and a baggage waggon. On foreign service, each battery had attached to it an entire company of artillery, and the proportion of artillery drivers and horses as stated in the following table. The corps of royal artillery drivers having been reduced, the guns are now driven by the artillery men, who are now taught to ride, drive, and take care of horses.

War Establishment of Drivers and Horses, as formerly attached to a Battery of Six Guns of different Natures, exclusive of a Company of Artillery.*

Nature of Batteries.	Offic^rs, R.A.D.	N.-Com^d Officers.		Drivers.	Trumpeters.	Artificers.			Total.	Horses.		
	Lieuts.	Serjeants.	Corporals.			Farriers and Smiths.	Collar Makers.	Wheelers.		Riding.	Draft.	Total.
12-Prs. Medium	1	1	4	74	1	2	1	1	85	18	123	136
9-Prs.	1	1	4	74	1	2	1	1	85	13	123	136
6-Prs. Heavy	1	1	3	53	1	2	1	1	63	12	84	96
6-Prs. Light	1	1	2	44	1	2	1	1	53	11	70	81

* This establishment will sometimes be varied in difficult countries, according to the judgment of the commanding officer of artillery; but will shew the least number that can be required to make a field battery efficient for a campaign in most countries.

To make a battery of 9-prs. to move with sufficient rapidity, and to carry the gunners fresh into action, eight horses per gun will be necessary, more particularly if a campaign is to be carried on in a country where the roads are bad. Six horses per gun may suffice for the same battery of horse artillery, where only two gunners are mounted on the carriage. The intelligent author of Remarks on the Organization of the Corps of Artillery, in a note, p. 161, states, "It cannot be too much recollected, that a gun badly manned, or inadequately horsed, is worse than of no use; and becomes a positive and very expensive evil."

Establishment of a Battery of three 9-Pr. Guns and one 24-Pr. Howitzer, as sent to Portugal, 1826.

Officers.	Surgeons.	N. C. Officers.	Gunners and Drivers.	Trumpeters.	Farriers.	Collar Makers.	Wheeler.	Total personal.	Guns.	Ammn Waggons.	Forge.	Reserve Ammunitn Waggons.	Store Waggon.	Spare Gun Carrge	Baggage Cart.	Total, Material.	Horses.
5	1	9	70	2	2	1	1	91	4	4	1	2*	1*	1*	1	14	65

Those carriages marked with a star were intended as a reserve and not horsed.

BEDS for Mortars.

Nature.		Weight.			Tonnage.			Length		Brdth		Height.	
		cwts	qr.	lb.	tons	cwt	qr	feet	in.	ft.	in.	feet	in.
	Sea	38	3	13	3	3	2						
13	Land, Wood	21	2	7	1	6	0	7	0	2	6	2	3
13	Ditto, Iron	50	0	0	2	10	0	6	3	3	1	1	6
	Sea.......	32	2	14	2	2	2						
10	Land, Wood	10	0	20	0	14	2	6	6	1	8	1	10
10	Ditto, Iron	23	0	0	1	3	0	4	8	2	4	1	1½
8	Land, Wood	6	0	20	0	7	2	4	2	1	7	1	7½
8	Ditto, Iron	12	0	0	0	12	0	4	0	1	11	0	11
5½	Wood	1	0	22	0	2	0	2	9	1	4	0	10
4⅖	Wood	0	3	11	0	1	2	2	4½	1	2	0	9

Stool Beds for Guns.

								Inches.		Inch.
42 Pounders ..	..	1	20	..	1	0	2	10	11 to 8¼	3¾
32 ———— ..	..	1	14	..	1	0	2	10	10 5½	¼
24 ———— ..	..	1	14	..	1	0	2	9	10¼ 6½	4
18 ———— ..	..	1	12	..	1	0	2	8	9½ 6⅓	3¾
12 ———— ..	..	1	10	..	0	2⅔	2	8	10 6½	4
9 ———— ..	..	1	4	..	0	2	2	7	½ 5¼	3½
6 ———— ..	..	1	0	..	0	1¾	2	6	9 4¾	3½
4 ———— ..	..	1	0	..	0	1	2	6	8¼ 5¾	3

BOXES for Ammunition.—The dimensions of the common laboratory ammunition boxes vary according to the ammunition they are made to contain, in order that it may pack tight; this variation, however, is confined to a few inches, and does not exceed the following numbers.

Table

Table of general Dimensions of Ammunition Boxes.

	Exterior.						Weight when empty.
	Length.		Breadth.		Depth.		
	feet	inches	feet	inches	feet	inches	lbs.
From ..	2	2	0	10	0	8½	20
To	2	9	1	6	1	6	30

Weight when filled, and number contained in each.

Nature of Ammunition.				Weight of Boxes when filled with Ammunition. cwts	qrs	lbs	N° of Rds contained in each Box. No.
Boxes for	Shot fixed with powder.	12-Prs.	Round	1	1	10	8
			Case	0	3	15	6
		6-Prs.	Round	1	7	7	12
			Case	1	0	15	12
		3-Prs.	Round	0	2	25	16
			Case	0	2	23	14
	Shot fixed to wood bottoms without powder.	24-Prs.	Round	1	1	26	6
			Case	2	0	0	6
		12-Prs.	Round	1	2	20	12
			Case	1	2	22	8
		6-Prs.	Round	1	2	20	24
			Case	1	1	12	18
		3-Prs.	Round	1	1	0	30
			Case	1	1	0	30
		Howitr Case.	8	1	2	2	3
			5½	1	2	12	10
			4⅖	1	2	22	20
	Shells.	Howitr Shells.	8 fixed	1	2		3
			5½ fixed	1	3	12	10
			4⅖ fixed	1	2	22	20

The common ammunition waggon will hold from 9 to 13 of these boxes in one tier.

The tonnage of ammunition in boxes is equal to its weight: about 12 boxes make one ton.

BOMB-Ketch.—The bomb-ketches upon the old establishment carry one 13-inch and one 10-inch mortar; with eight 6-pounders, besides swivels, for their own immediate defence. The modern bomb-vessels carry two 10-inch mortars, four 68-pounders, and six 18-pounders carronades: and the mortars may be fired at as low an angle as 20 degrees; though these mortars are not intended to be used at sea, but on very particular occasions, their principal intention, at these low angles, being to cover the landing of troops, and protect our coast and harbours. A bomb-ketch is generally from sixty to seventy feet long from stem to stern, and draws eight or nine feet water. The tender is generally a brig, on board of which the party of marine artillery remain, till their services are required on board the bomb-vessel.

Instructions for their Management and security in Action.

1. A Dutch pump, filled with water, must be placed in each round-top; one upon the fore-castle, one on the main-deck, and one on the quarter-deck; and furnished with leather buckets, for a fresh supply of water.

2. The booms must be wetted by the pumps before the tarpaulins

tarpaulins and mortar hatches are taken off; and a wooden screen, 5 feet square, is to be hung under the booms, over each mortar, to receive the fire from the vents.

3. The embrazures being fixed and properly secured, the port must be let down low enough to be covered by the sole of the embrazure. Previous to its being let down, a spar must be lashed across it, to which the tackle for raising it again must be fixed: This spar serves to project the tackles clear of the explosion.

4. The mortars must not be fired through the embrazures at a lower angle than 20 degrees, nor with a greater charge than 5lbs. of powder.

5. Previous to firing, the doors of the bulk-head, under the quarter-deck, must be shut, to prevent the cabin being injured by the explosion.

6. The bed must be wedged in the circular curb, as soon as the mortar is pointed, to prevent re-action; the first wedge being driven tight before the rear ones are fixed, in order to give the full bearing on the table, as well as the rear of the bed.—The holes for dog-bolts must be corked up, to prevent the sparks falling into them.

7. When any shells are to be used on board the bomb, they must be fixed on board the tender, and brought from thence, in boxes, in her long boat; and kept along-side the bomb-ship till wanted, carefully covered up.

8. In the old constructed bomb-vessels it is necessary to hoist out the booms, and raft them along-side previous to

firing;

firing; but in these new ones, with embrazures, only the boats need be hoisted out; after which the mortars may be prepared for action in ten minutes.

Proportion of Ordnance and Ammunition for a Bomb-Ship, carrying two 10-*Inch Mortars, to fire at low Angles, and at* 45 *Degrees, Four* 68-*Prs. and Six* 8-*Prs. Carronades.*

Nature.	In the Bomb-ship.	Tender.	Total.
Mortars, sea service, with beds, &c. 10-inch	2	..	2
Coins for do.—2 for 45°—2 for 26° elevation	4	..	4
Cap squares, with keys, &c. spare	2	..	2
Hand-spikes ... large	4	..	4
Sponges, with rammer heads	4	..	4
Handscrews ... small	2	..	2
Hand-crow levers—6 feet	4	..	4
Handspikes ... common	6	..	6
Linstocks, with cocks	4	..	4
Powder-horns ... new pattern	4	..	4
Match ... cwts.	1	..	1
Marline ... skeins	..	12	12
Budge Barrels ... copper hooped	1	1	2
Lanthorns, Muscovy	2	2	4
———, dark	2	2	4
Carronades, 68-Prs.	4	..	4
———, 18-Prs.	6	..	6
having sliding carriages, elevating screws, sponges rammers, &c. comp[te]			
Gun Tackles, complete, for Traversing Mortars ... 12-Prs.	4	..	4

Proportion of Ordnance, &c. for a Bomb Vessel.—Continued.	Bomb.	Tender.	Total.
Wads ....68-Prs.	270	270	540
—— ....18-Prs.	480	180	660
Musquets...... bright...........	32	..	32
Musquets...... black	8	..	8
Pistols..........pairs............	15	..	15
Swords	40	..	40
Pole-axes	6	..	6
Pikes	40	..	40
Musquetoons.....................	2	..	2
Flints ....Musquet	900	..	900
——........Pistol..............	150	..	150
Ball Cartridges, Musquet	2000	..	2000
——————, Pistol...............	2000	..	2000
Shot .... Musquet, cwts. qrs. lb.	1.0.0	..	1.0.0
—— .... Pistol	0.1.1	..	0.1.1
Round Carcasses, fixed.....10-inch..	48	152	200
Empty Shells ....10-inch..	48	352	400
Iron Shot .... 1 lb.....	1000	4000	5000
Fixed Shells ....10-inch..	48	..	48
Case Shot....68-Prs. Carronades	20	20	40
Empty Shells .. 8-inch. for Carronades	52	100	152
Shot, round ....68-Prs..........	50	50	100
Carcasses, ditto......68-Prs.........	96	104	200
Shot round ....18-Prs..........	300	..	300
Case Shot...........18-Prs.........	30	30	60
Carcasses, do. fixed ..18-Prs.........	150	150	300
Hand Shell, fixed, sea service	..	150	150
Fuzes for ditto, spare	..	15	15
Paper Covers for Cartridges, 10-Inch..	106	609	715
—————————— 68-Prs. ..	293	301	594
—————————— 18-Prs. ..	528	198	726
Flannel Cartrid. empty, for 10-Inch Mortars — to hold 5lbs.	106	..	106
Flannel Cartrid. empty, for 10-Inch Mortars — do. 10lbs.	..	609	609
Flannel Cartrid. empty, for 68-Prs. Carronad. — to hold 5lbs.	293	151	594
Flannel Cartrid. empty, for 68-Prs. Carronad. — do. 4lbs.	..	150	

Proportion of Ordnance, &c. for a Bomb-Vessel.—Continued.	Bomb.	Tender	Total.
Flannel Cartridges empty, for 18-Prs. to hold $1\frac{1}{2}$ lbs.	528	198	726
Paper Cartges for bursting, 10-In. empty	..	352	352
————, 8-Inch, empty	..	100	100
Do. filled with 2lb. 10oz. for 10-Inch	48	..	48
———— 1lb. 14oz. 8-Inch	52	..	52
Fuzes, drove. 10-Inch	52	388	440
———— 8-Inch	57	110	167
Valenciennes Composition. 200 for 10-Inch Shells at 14 oz. each—lbs.	..	175	175
Valenciennes Composition. 768 for 10-Inch Shells at 2 oz. each—lbs.	..	42	42
Tube boxes, tin.	12	..	12
Fuze Compn for priming carcasses. .	..	10	10
Powder Bags	..	6	6
Port-fires.	..	200	200
Quick-match, cotton. . . . . .lbs.	..	20	20
Spirits of Wine. . . . . .gall.	..	4	4
Kitt. . . . . .lbs.	..	80	80
Bottoms of wood . . . . .10-Inch. .	10	40	50
Signal Rockets, 1 lb. . . . . .dozens. .	..	2	2
Blue Lights. . . . . .ditto . . .	..	3	3
Gunpowder for the mortars and carronades . . . . .half barrels	72	150	222
Powder for priming . . . . $\frac{1}{2}$ barrels. .	..	1	1
Powder for bursting . . . . . . $\frac{1}{2}$ barrels. .	..	28	28
with all the small articles which usually attend mortars on every service, and the articles necessary for the service of carronades at sea.			
Laboratory Chests. . . . . .4 feet. .	..	2	2
———— . . . . .3 feet. .	..	2	2
Hand-pumps for wetting the rigging, &c.	6	..	6
Leather buckets	24	..	24

BREACH.

The batteries to make a breach, should commence by marking out as near as possible, the extent of the breach intended to be made; first, by a horizontal line within a fathom of the bottom of the revetement in a dry ditch, and close to the water's edge in a wet one; and then by lines perpendicular to this line, at a short distance from each other, as high as the cordon; then, by continuing to deepen all these cuts, the wall will give way in a body.—The guns, to produce the greatest effect, should be fired as near as possible in *salvos* or vollies.—The breach should be one-third the length of the face, from the centre towards the flanked angle. When the wall has given way, the firing must be continued, to make the slope of the breach practicable.

Four 24-pounders from the lodgment in the covert-way will effect a breach in four or five days, which may be made practicable in three days more.

Another way of making a breach is, by piercing the wall sufficiently to admit two or three miners, who cross the ditch, and make their entry during the night into the wall, where they establish two or three small mines, sufficient to make a breach.—(See *Artillery at a Siege; see also Battery.)*

If a town is fortified in a regular manner, according to the modern systems, it can only be battered in breach from the crests of the glacis; but an ancient fortress, where some

some part of the scarp is usually uncovered, and may be seen from a distance, the breaching batteries may be established from 4 to 600 yards from the intended breach: this was fully exemplified in the sieges of Ciudad Rodrigo, Badajos, and St. Sebastian. The total number of hours firing at Ciudad Rodrigo was $32\frac{1}{2}$, as follows.

	Hours.
Jan. 14th, 1812. Firing from 20 24-prs. and 2 18-prs.	1
14th. The whole day, from 23 24-prs. and 2 18-prs. to form the great breach........	$8\frac{1}{2}$
16th. Foggy weather—firing from 23 24prs. and 2 18-prs.........................	1
17th. Foggy—firing from 23 24-prs. and 2 18-prs.	5
18th. Clear—from 30 24-prs. and 2 18-prs. to form the small breach	$8\frac{1}{2}$
19th. Clear—from 30 24-prs. at 4 p.m. both breaches considered as practicable, fire turned on defences, and place assaulted at 7 p.m..............................	$8\frac{1}{2}$
Total firing hours..	$32\frac{1}{2}$

Both breaches were formed from a distance between 500 and 560 yards, the small breach 30 feet wide, and the large one 100.

It has been calculated that with 40 24-prs. iron, and an expenditure of 164 rounds to each, being 6560, the large breach would have been more than rendered practicable in $8\frac{1}{2}$ hours, or during day-light of one day.

Time

Time of firing at Badajos.

		Hours.
March 30th.—8 18-prs.		13
31st.—8 18-prs. 12 24-prs. 6 18-prs.	26 guns	13
April 1st...26 guns as before		13
2d.........ditto		13
3d.........ditto		13
4th........ditto		13
5th........ditto		13
6th........ditto, 14 of which to form curtain breach..		13
	Total..	104

The three breaches (of which the curtain one was 40 feet wide, the flank 90 feet, and the large one in the face of the bastion 150 feet) were rendered practicable from a distance of between 6 and 700 yards. Fourteen of the iron 18-prs. were Russian guns, cast at Carron, and mounted on English carriages, the shot fired from them chiefly English, consequently the windage greater than if English guns had been used, and the force less. If 50 English iron 24-prs. had been used with 250 rounds each, the large breach might have been made in 13 hours, or during daylight of one day.

Time

Time of firing at the first part of the Siege of St. Sebastian, July, 1813.

	Hours.
July 20th.—Battering the whole day from 20 24-prs.	15½
21st.—Ditto, guns as before	15½
22d.—Ditto, ditto, the large breach of 100 ft. practicable this eveng	15½
23d.—The 20 guns turned to form the small breach of 30-feet practicable this evening	15½
Total firing	62

Fifty 24-prs. would have rendered the large breach practicable in one day, distance about 600 yards.

BRIGADE.—See *Battery of Field Artillery.* The term brigade for a field battery was first used when 3 pairs of battalions guns were joined together, but in the horse artillery it is applied to the whole body, of whatever number of troops it may consist. The term field battery is now, more properly than *brigade*, generally adopted to express a command consisting of four or six guns.

BRIDGES.—Manner of laying a pontoon bridge across a river.

The bank on each side, where the ends of the bridge are to be, must be made solid and firm, by means of fascines or

or otherwise. One end of the cable must be carried acro the river; and being fixed to a picket, or any thing fir must be drawn tight by means of a capstan, across whe the heads of the boats are to be ranged. The boats a then launched, having on board each two men, and t necessary ropes, &c. and are floated down the stream, und the cable to which they are lashed end-wise, by the rin and small ropes, at equal distances, and about their ov breadth asunder, more or less, according to the streng required. If the river be very rapid, a second cable mu be stretched across it, parallel to the first, and at the di tance of the length of the boats, and to which the oth end of the boats must be lashed. The spring lines are th lashed diagonally from one boat to the other, to brace the tight; and the anchors, if necessary, carried out, up t stream, and fixed to the cable or sheer line across the rive —One of the chesses is then laid on the edge of the ban at each end of the bridge, bottom up: these serve to l the ends of the baulks upon, and as a direction for placi them at the proper distances, to fit the chesses that cov the bridge.—The baulks should then be laid across th boats, and keyed together: their numbers proportioned the strength required in the bridge.—If the gang-boar are laid across the heads and sterns of the boats from o side of the river to the other, they will give the men footing for doing the rest of the work.—Across the baul are laid the chesses, one after another, the edges to mee

nd the baulks running between the cross pieces on the nder side of the chesses. The gang-boards are then laid ross the ends of the chesses on each edge of the bridge.

Precautions for passing a Bridge of Boats.

Whatever size the bridge may be, infantry should never e allowed to pass at the same time with carriages or valry.—The carriages should always move at a certain stance behind each other, that the bridge may not be ook, by being overloaded.—The horses should not be lowed to trot over the bridge; and the cavalry should smount and lead their horses over.—Large flocks of cattle ust not be allowed to cross at once.

For the dimensions, weight, and equipage of a pontoon, e the word *Pontoon*.

When bridges are made to facilitate the communication etween different parts of the approaches at a siege, they hould, if possible, be placed above the town; or the be-eged will take advantage of the current to float down rge trees, or other bodies, in order to destroy the bridge. wo of such bridges should always be placed close to each ther, in order to prevent the confusion of crossing and -crossing on the same bridge; the one being intended to ss over one way, and the other to return. Pontoon idges will generally not support a greater weight than 4 5,000 pounds.—Pontoons, when united as a bridge, will o doubt bear more in proportion, than when acted upon

 separately

separately: but the weight which a pontoon will bear may be easily ascertained, by loading it with water till it sinks to any required depth, and then by calculating the number of cubic feet of water it contains, ascertain the number of pounds required to sink it to that particular depth.

Considerations respecting the situation of Bridges.

1. Do not construct your bridge below an angle of the river which is covered with wood or rocks: if obliged to do so, place sentinels for a considerable distance above, who will give timely notice of any attempt on the part of the enemy to destroy your bridge by floating trees or combustible matters down the stream; thus their attempts may be rendered ineffectual, by opening the bridge in time to let them pass through. Bridges are sometimes so constructed as to be swung to one side, or to open in the middle and swing half to each side; in this case strong gun ropes must be used to ease off, and the bridge strengthened by additional pieces of timber lashed from pontoon to pontoon.

2. Avoid such places as require much labour in ramping off the banks; a height of 4 or 5 feet above the surface of the water is most convenient: if higher, it may be necessary to place tressels in the boats, to raise the bridge.

3. A flying bridge is best established on a straight part of a river where the current is steadiest and there is less eddy.

4. Avoid

4. Avoid the positions where the opposite bank commands your own, and those also where the water is so shallow as to allow the boats to strike the bottom: if the banks are even, choose the spot where the opposite bank is free from rocks, bushes, or any thing which might cover an enemy from the fire of your own troops and artillery.

5. For bridges of communication only, without regard to offence or defence, the straight parts of a river are less affected by floods or decrease of water, and the bottom less muddy. At a re-entering angle the water is generally shallower on the convex side.

6. Place your bridge, if possible, in a re-entering angle; your batteries for its defence will then be in advance of the bridge, although on your own side of the river, and will protect your troops in advancing and retreating by their cross fire, to a greater distance. If, however, the bridge is to be permanent, and the river is much affected by sudden floods, a re-entering angle would not be advisable, as at such time the current runs with greater rapidity at the elbow opposite the re-entering angle than at any other point, and might endanger the safety of the bridge; choose, then, a situation where the banks are of equal height, and where the water is always kept within bounds, otherwise you will be obliged to lengthen the bridge, and the sudden retiring of the waters would cause some of the supplementary boats to strike the bottom, and break the bridge.

7. Take

7. Take advantage of the confluence of rivers on your own side, and place your bridge below them: form parts of two or more boats, as may be most convenient, on the river, according to its breadth, which runs into the one over which you intend to throw your bridge, and you will thus facilitate its construction.

8. If, during a siege, you are obliged to establish a communication across a river, between the different points of attack, take care to have two bridges, one for passing, and another for re-passing: let these, if possible, be above the town; if below, secure them from the enemy's attempts at destroying them, by a chain of piles placed between them and the town. Care must, however, be taken to clear the piles as often as possible from rubbish, trees, &c. otherwise the force of water in a flood breaking down a part of the piles, would bring down upon the bridge in mass what would have reached it only in detail. The piles should be 18 feet in length, and 10 or 12 inches square. Perhaps it might be better to range the piles diagonally, placing them farthest from the bridge on the opposite bank, or in form of a fleche, with the salient angle up the stream. The rubbish, by this latter method, will fall off to either side, leaving a free course for the water in the centre; and may be more easily disengaged. The piles should be placed 2 or 300 yards above the bridge, and about 4 or 5 feet distant from each other, if the time and materials will allow it.

On

On tide rivers use no more boats or pontoons than will float at low water, but continue the communication by piles, rafts, or tressels. Pontoons ought not to be used in a river above 350 feet wide. Boats or barges are preferable for wide or tide rivers, as they resist a swell better, and admit of undulatory individual motion.

There are various methods of forming temporary bridges, when pontoons or boats are not at hand. The following are sometimes used, viz. tressels, carriages, or waggons, placed at certain distances, and laid with baulks and chesses; large gabions, so placed as to allow the water to pass through, may be laid in tiers in the middle of the stream, and the sides, or part of the river unoccupied by the gabions, filled up with water fascines. It would be advisable to cover all temporary or slight bridges with straw or turf, which adds to the elasticity, and takes off a part of the pressure.

A bridge may be formed with casks fastened together in pairs with short beams, and arranged in masses, forming so many rafts, which may be afterwards joined together, and covered with the baulks and chesses. When anchors are not to be had, blocks of stone, with rings soldered into them, with lead, or pyramidical gabions, filled with stones, may be used, to the base of which a cross should be attached, which will prevent their dragging in muddy bottoms.

A bridge may be constructed for the passage of infantry, over a rivulet or ravine, with high rocky margins, by means

means of 6 or more cables stretched by capstans across from bank to bank; the ends should be fixed to strong pickets or trees, and be supported by a strong tressel on each side: at certain distances slight chessels must be lashed across the cables, to support the ends of the hurdles or fascines which cover the platform.

In 1814 the Duke of Wellington passed the Adour by a bridge of chasse-marées on the deck of each was a sleeper, 10 inches square, placed longitudinally, in it were 5 notches to receive 5 cables 13 inches each in circumference, and 120 fathoms long. The breadth of the river was 810 feet, bounded on each side by a stone wall 14 feet high; after the cables were secured at one end, they were stretched by capstans, and the bridge laid over them.

Cavalry generally march two and two over a bridge—their total weight, horses, appointments, and baggage, about 2632lb. A horse takes about nine feet in length on the march, consequently every pontoon will have to support that weight. Infantry generally march over a bridge by fours. Each pontoon will have to support 20 men or five ranks; at 180lbs. per man, or 3600lbs. A 9-pounder gun carriage and limber about 4956lbs.—but this weight rests on two or three pontoons, according to the distance they are placed; therefore infantry press heavier on a bridge, but this may be much reduced by opening the files.

CAMP.

CAM

CAMP.—With some trifling variations, camps are formed after the same manner in all countries. This principle seems general, that there should not be more ground occupied by the camp of a body of men, in front, than the extent of their line when drawn out in order of battle.—Intervals are, however, generally left between battalions of infantry of about one-eighth their front, and between squadrons of cavalry of thirty or forty paces. An army is sometimes encamped in two lines, and sometimes in three: the distance between the lines varies according to the face of the country, from 200 to 600 yards, or more.

In the distribution of the front of a camp, two feet are generally allowed for every file of infantry, and three feet for each file of cavalry. When the ground will admit of it, the infantry are usually arranged in rows perpendicular to the front; each row containing the tents of one company; and the cavalry in the same position; each perpendicular row containing the horses of a troop.

The grenadiers and light infantry are usually placed in single rows on the flanks, and the battalion companies in double rows.

A single

A single row, or one company, occupies in front, nine feet; and a double row, or two companies, twenty-one feet, if formed of the old pattern rectangular tents, which hold only five men each. But if the new bell tents are used, 15 feet must be allowed for a single row, and 30 feet for a double row in front.

In the cavalry, a row or troop occupies in front as follows:

	Old Tents.	New Tents.
Tent	3 yards.	5 yards.
From the front pole of the tent to picket rope	3	3
For the horse	6	6
For the dung................	2	2
	14 yards.	16 yards.

The breadth of a row in front, whether of infantry or cavalry, being multiplied by the number of rows, and the product subtracted from the whole extent of front from a battalion of infantry, or a squadron of cavalry, will leave the space of the streets, which are generally divided as follows:

For the infantry, 59½ feet each.

For the cavalry, 30 feet each between the tents.

——— 46 ——— horses.

The

The following is the Distribution of the Depth of a Camp of Infantry or Cavalry, when the Ground permits.

Distribution of the Depth of a Camp.	Infantry.	Cavalry.
	Yards.	Yards.
From the quarter guard parade to the line of parade of battalion	62	
From this first line of parade to the front of the serjeants' tents	16	
of the quarter-master's	..	24
N.B. These tents open to the front.		
To the first picket of horses	..	5
Infantry; for every tent in depth		
——— old pattern, 9 feet		
——— new pattern, 15 feet		
Cavalry: for every horse, 3 feet........		
The soldiers' tents for the infantry open to the streets.—The cavalry tents front to the horses' heads.		
Suppose infantry 12 tents deep / ——— cavalry, 60 horses .. } O. P. ..	36	60
From the last tent of infantry, or the last horse of the cavalry, to the front of the subalterns' tents	15	12
These tents open to the rear.		
Carried on..	129	101

Distribution

Distribution of the Depth of a Camp. Continued.	Infantry.	Cavalry.
	Yards.	Yards.
Brought on..	129	101
To the front of the line of captains......	15	15
These open to the front. The captains' and subalterns' in the rear of their troops or companies.		
To the front of the field officers	10	15
Open to the front, opposite the outside street of the battalion.		
To the colonels........................	10	10
Open to the front, opposite the main street of the battalion.		
To the staff officers	10	14
Open up the streets, next the main street.		
To the first row of bâtmens' tents	10	
The bâtmens' tents front their horses.		
To the first row of pickets for bât horses.	2	15
To the second row of ditto	10	
To the second row of bâtmen..........	2	
To the front of the grand sutler's tent ..	10	
The grand sutler is in the rear of the colonel.		
To the centre of the kitchens	15	20
The kitchens are 16 feet in diameter.		
To the front of the petty sutlers........	15	15
Directly in the rear of the kitchens they are allowed 6 yards in front by 8 deep.		
To the rear-guard.....................	15	15
Opens to rear.		
Total depth required—Yards..	253	220

If

If the ground on which the camp is to be formed will not, from a swamp in the rear, or any other circumstance, admit of each troop or company being formed in one row perpendicular to the front; the distribution of the front of a battalion or squadron must be more contracted than the above, and laid out as follows: Find how many perpendicular rows will be required, by dividing the number of men in the battalion or squadron by the number the ground will admit of in one row; then the number of rows being multiplied by the breadth of one in front, will give that part of the front to be occupied by the rows; and the difference between it and the whole front allowed for the battalion or squadron, will be left for the streets; which, if the streets are to be equal, must be divided by their number, to find the breadth of each; or is otherwise easily divided into streets of unequal breadths.

For the proper positions of camps, see the word *Reconnoitring*; and for the encampment of a park of artillery, see the word *Artillery of the Park*.

	cwt	qrs.	lb.
CAPSTAN CRAB.—Weight—	3	0	20

CARCASSES.—Composition.

Saltpetre	50 parts.
Sulphur	25
Antimony	5
Rosin	8
Pitch	5

Valenciennes

Valenciennes composition, so called from its having been used by the Austrians at the seige of that place, has the effect of making shells answer the purpose of carcasses after they burst.

Saltpetre	50 parts.
Sulphur	28
Antimony	18
Rosin, or Swedish pitch	6

This composition is cast in copper cylindric moulds of 6 inches long, and of different diameters, according to the shell in which it is to be used. It must be put in along with the bursting powder in pieces as large as the shell will admit, without preventing the fuze being driven down.

CARCASSES,—Their dimensions and weight.

Nature.		Weight. Empty.			Weight. Of Composition.			Weight. Complete.			Time each will burn.
Round, for		lbs.	oz.	drs	lbs.	oz.	drs	lbs.	oz.	drs	Minutes
Mortars and Howitzers	13	194	10	11	18	14	..	213	8	16	11
	10	89	13	11	7	8	11	97	6	11	$8\frac{1}{2}$
	8	44	9	5	4	4	11	48	14	..	$5\frac{1}{2}$
For Guns	42	27	3	..	2	7	11	29	10	11	5
	32	20	13	5	1	14	5	22	11	11	$4\frac{1}{2}$
	24	14	12	..	1	9	11	16	5	11	4
	18	11	13	11	1	1	5	12	15	..	4
For Carronades	68	..	..	..	..	..	..	..	..	..	..
	42	26	..	..	2	7	..	28	7	..	$4\frac{1}{2}$
	32	21	10	..	1	13	..	23	7	..	4
	24	14	5	..	2	5	..	16	10	..	$3\frac{1}{2}$
	18	10	4	..	1	2	..	11	6	..	3
Oblong, for											
Mortars & Howitzers	10	36	7	5	35	10	..	72	1	5	12
	8	16	5	5	18	2	..	34	7	5	10
	$5\frac{1}{2}$	1	12	2	6	15	..	8	11	3	6
	$4\frac{2}{5}$	1	0	6	8	11	7	4	11	13	4

Note.—It being found at the siege of Quebec, that the quantity of powder requisite for throwing the carcasses into the town, always destroyed them, the method of filling the interval between the powder and carcass with turf was adopted, and found to preserve the carcass, and to produce every desired effect.

CARRONADES,—Their Weight and Dimensions.

Nature.	Diameter of Bores.	Length in Ft.	In.	Calibers	Weight. cwt	qrs	lb.	Proportion between the Shot and Carronade.
68 Prs.	8·05..	5	2	7·702	36	..	..	59 to 1
68 ——	..	4	0	5·962	29	..	..	
42 ——	6·84..	4	$3\frac{1}{2}$	7·518	22	1	..	58 to 1
32 ——	6·35..	4	$0\frac{1}{2}$	7·679	17	..	14	62 to 1
24 ——	5·68	3	$7\frac{1}{2}$	7·656	13	..	..	56 to 1
	5·68	3	0	6·336	11	2	25	
18 ——	5·16	3	3	7·587	9	..	..	56 to 1
	5·16	2	4	5·447	8	1	25	
12 ——	4·52..	2	2	5·778	5	3	10	56 to 1

N.B. Carronades have not so much windage as guns. See *Windage*.

Ranges with carronades, 1813.—The charge is $\frac{1}{12}$ the weight of the shot; and with one shot and one wad.—The line of the fire from 6 to 9 feet above the level of the water.

Nature.	68	42	32	24	18	12
Charge.	5lb. 8oz.	3lb. 8oz.	2lb 10oz	2lb.	1lb. 8oz.	1lb.
P. Blank..	450yds	400	330	300	270	230
1 Degree	650	600	560	500	470	400
2 ——	890	860	830	780	730	690
3 ——	1000	980	900	870	800	740
4 ——	1100	1020	970	920	870	810
5 ——	1280	1170	1087	1050	1000	870

Note.—The highest charge for carronades is $\frac{1}{8}$ the weight of the shot; the lowest $\frac{1}{16}$.

Ranges

Ranges with 8-inch Shells, from 68-Pr. Carronades.

Shells' Weight.	Charge	Flight.	Elevation.	First graze.	Extreme range.
lbs. oz. 43 11	3 lbs.	$1\frac{1}{2}$	P. B.	302	1365
	8 —	..	5 Degrees	1140	
	4 —	$1\frac{1}{2}$	1 ——	358	1843
	....	5	5 ——	1137	1250
	....	..	$11\frac{1}{2}$ ——	1767	

Weights of various natures of Travelling Carriages, with limbers, complete, exclusive of the gun.

		cwt.	qrs.	lbs.
24-pounder, iron, 9 feet, 6 inches.	carriage	28	2	27
18-pounder, ditto, 9 feet	carriage	25	1	27
12-pounder, ditto, 9 feet	carriage	24	0	6
12-pounder, ditto, 6 feet	carriage	18	1	4
24-pounder, or $5\frac{1}{2}$ inch iron howitr	carriage	17	3	5

Weights

Weight of the new Block Trail Carriages and new Pattern Ammunition Carriages, when equipped.

	cwt.	qrs.	lbs.
12-pounder medium, gun, carriage, and limber, with ammunition	42	0	0
Ammunition carriage, and limber to ditto, with ammunition	29	0	0
9-pounder gun, &c.	39	1	0
Ammunition carriage, &c. for ditto	26	0	0
6-pounder heavy gun, &c.	37	2	0
Ammunition carriage, &c. for ditto	27	2	0
6-pounder light gun, &c.	27	2	0
Ammunition carriage, &c. for ditto	26	0	0
3-pounder heavy gun, &c.	26	0	0
Ammunition carriage, &c. for ditto	23	2	0
8-inch howitzer, &c.	40	3	2
5½ ditto, heavy	36	1	0
Ammunition carriage, &c. for ditto	27	1	5
5½-inch howitzer, light	27	1	0
Ammunition carriage, &c. for ditto	27	0	0
Ditto, 6-pounder wheel carriage, complete	27	0	24

N.B. Some slight alterations are making which will add a trifle to the weight of some of these carriages and deduct from others, but the above is as near the weight as could be ascertained.

Park

Park Carriages.

	cwt.	qrs.	lbs.
Ball cartridge cart, empty	8	0	20
Ditto, loaded	21	1	14
Hand cart	3	3	0
Trench cart	4	3	27
Truck carriage	12	2	21
Sling cart	15	0	2
Large devil carriage and limber	27	3	0
Small ditto	7	2	3
Cavalry forge cart, with stores	11	3	18
Forge waggon, with limber and stores	21	2	23
Store waggon, with limber, empty	17	3	21

All the field carriages are now made with iron axletrees, which are more durable than wood; their diameters being less, the friction is thereby decreased, and they require less grease. There are but two sorts used, heavy and light.

Dimensions

Dimensions and Weights of standing Gun Carriages.

Natures.	42 & 6	32	24	18	12	9	6
	feet. inches.	ft. inch.	ft. inch.	ft. inch.	ft. inch.	ft. inch	ft. inch.
Axle-tree, total length	5 0	4 10	4 6½	4 5	4 1	4 0	3 10
Axle-tree, Depth. .. Fore ..	11	11	11	10½	10½	10½	9½
Axle-tree, Depth. .. Hind ..	7¾	7¾	6¾	6¾	6¾	6¾	5¾
Axle-tree, Thickness Fore, Hind	7¾	7¾	6¾	6¾	6¾	6¾	5¾
Axle-tree, Width...........	1 0	1 0	1 0	1 0	1 0	1 0	1 0
Length of bracket........	6 5	6 3	6 2	6 1	5 9	5 8¼	5 7
Thickness of ditto........	6	6	5½	5	4½	4	3¼
Depth of ditto	2 3	2 2½	2 2	2 1	2 1	2 0	2 0
Width before..........	1 6¾	1 5½	1 4¾	1 3¾	1 1⅞	1 0⅞	11¾
Width behind	2 0½	1 11¾	1 11	1 9	1 7½	1 6½	1 5¼
Diameter of iron trucks, Fore	1 6¾	1 6¾	1 6¾	1 6¾	1 6¾	1 6¾	1 6¾
Diameter of iron trucks, Hind	1 3¾	1 3¾	1 3¾	1 3¾	1 3¾	1 3¾	1 $3\frac{2}{4}$
Diameter of arm of axle ¼ of an inch less than the bore of the truck......	7½	7½	7½	6½	6½	6½	5½
	cwt. qrs. lbs.	cwt.qrs.lbs	cwt qrs.lbs	cwt.qrs.lbs	cwt qrs.lbs	cwt.qrs.lbs	cwt.qrs.lbs
Weights of the carriage, bed, trucks, and coins, complete	16 3 13	15 1 0	13 2 0	12 3 0	11 3 0	10 1 0	9 1 0

Weight of Brass Howitzer standing Carriages.

10-inch	21	1	7
8-inch	16	2	23

Standing gun carriages of cast iron have lately been introduced in the service for warm climates and situations not much exposed; their weight, including the trucks, are as follows:

	cwt.	qrs.	lbs.
32-pounder	25	2	0
24	19	3	25
18	16	3	0
12	16	1	0
9	15	0	0
6	14	3	0

An experiment was made at Sutton Heath, 1810, with an 18-pounder iron carriage, which stood the first part of the practice with high charges and elevations, but afterwards the bed broke with a reduced charge and low elevation. The trunion of an 18-pounder gun, on a cast iron carriage, at Landguard Fort, broke off the same year at the twenty-seventh round that day.

Carriages on a march—see *Marching*.

For wood of which carriages are made, see *Wood*.

CARTOUCHES.—The cartridges carried by the batteries of field ordnance are packed in canvas cartouches, and distributed as follows:

12-Pr.	Gun Limber			3
	Ammunition Carriage	Limber		4
		Body,	Fore	2
			Hind	2
9-Pr.	Gun Limber			4
	Ammunition Carriage	Limber		4
		Body,	Fore	3
			Hind	3
6-Pr. Heavy and Light,	Gun Limber			4
	Ammunition Carriage	Limber		4
		Body,	Fore	3
			Hind	2
3-Pr.	Gun Limber		Near	2
			Off.	2
	Ammunition Carriage	Limber		4
		Body,	Fore	2
			Hind	2
5½ howitzer, Heavy or Light,	Howitzer Limber			2
	Ammunition Carriage	Limber		2
		Body,	Fore	1
			Hind	1
24-Pr. Howit^r^ 12-Pr. Howit^r^	One in each Box.			

N.B. The cartouches for the gun limber boxes, and for the limbers of the ammunition carriages, have leather bottoms.

CARTRIDGES for guns.

Of Paper.	Weight of one Dozen.			Length.		Tonnage. No. packed in ¾ Ton Vat.
Pounders.	lb.	oz.	dr.	Feet.	In.	Number.
42	3	0	0	2	4	1000
32	3	0	0	2	4	1100
24	3	0	0	2	4	1400
18	2	14	0	2	4	1500
12	2	4	0	2	4	1600
9	2	4	0	2	4	1800
6	1	5	0	2	0	2000
4	1	1	0	1	7	2200
3	1	1	0	1	7	2200
Of Flannel.						
42 and 32	2	2	0	2	3	The tonnage of flannel cartridges is ⅕ more than that of paper.
24 Heavy	1	12	0	1	10	
24 Medium	1	6	0	1	5	
24 Light	1	1	8	1	0	
18	1	6	0	2	3	
12 Heavy	1	3	0	1	6	
12 Medium	0	11	0	1	2	
12 Light	0	8	0	0	10	
9	0	10	0	1	4	
6 Heavy	0	14	0	1	1	
6 Medium						
6 Light	0	5	0	0	9½	
3	0	6	0	0	1	
13-Inch Mortar	1	2	8	1	6	
10	0	10	8	1	1	
8	0	7	0	1	0	
5½	0	4	0	0	9	
4⅖	0	3	0	0	7	
8-Howitzer	0	10	8	1	1½	
5½	0	4	8	0	9½	
4⅖	0	4	0	0	9½	

Cartridges

Cartridges for small arms.

Nature.	Powder contained in each Cartridge.	No. of each tied in one bundle.	No. contained in one Barrel. whole.	No. contained in one Barrel. half.	Weight of one Barrel filled. whole. ct.	qr.	lbs.	Weight of one Barrel filled. half. qr.	lb.	1 Sheet of Paper makes.
	drms	No.	No.	No.	ct.	qr.	lbs.	qr.	lb.	No.
Wall pieces .	10	6	1400	500	2	2	19	3	24	6
Musquet ..	6	10	2100	1000	1	3	10	3	24	12
Carbine ...	4	10	2853	1500	1	3	7	3	26	16
Do. pissol ..	3	10	4400	1500	1	3	17	3	21	24
Com. pistol .	3	10		2000				3	11	24
7 Bar. guns .	1½	14		1000 in kegs						

Musquet ammunition, &c. is now carried in a limber waggon constructed to carry 20 boxes; each empty box weighing 12lbs. and capable of containing 1000 cartridges. The same description of waggon carries 14 powder-cases, 80lb. of powder in each case: these boxes are contrived so as to be carried on mules.

An experienced boy will form about 1000 ball-cartridges per diem, the paper being first cut to the size;—another will pack 4000, or 400 packages of 10 cartridges in each; —another boy will fill 1000 with powder. About 1½oz. of twine is used to make and pack 1000.

Musquet

Musquet *Cartridges*, by different Powers in Europe.

Weight of	English.	Hessian.	Austrian.	Dutch.	French
	oz. dr. gr.	oz. dr. gr.	oz. dr. gr.	oz. dr. gr.	oz. dr. gr.
Powder .	0 6 0	0 7 10	0 6 13	0 10 10½	0 7 4½
Cart^gs complete..	1 9 11	1 7 2	1 6 4	1 12 4	1 6 0

CASE SHOT.—*See Shot.*

CHAMBERS.—In 1787 and 1789 experiments were made at Woolwich with an 8-inch mortar, with four shifting chambers, to ascertain which form gives the longest range.

The chambers were all of the same capacity, viz. 63·7 cubic inches, and contained two pounds of powder.—Their forms were :—

1st. Common conical chamber with the circular bottom.

2d. The same reversed.

3d. The cylindric chamber with circular bottom.

4th. The spheric chamber.

The ranges were the medium of 6 rounds; from them it appears, that when the spheric chamber is filled with powder, it has the advantage in point of range; but when smaller charges are used, its ranges are found to be shorter than those of other forms. The conical (No. 1,) chamber of the present establishment gives the longest range under other circumstances.

Charges of Powder for Round and Case Shot, Land Service.

			lbs.	oz.
Carronades $\frac{1}{12}$ of Shot's weight,	68-Pounders		5	12
	42		3	8
	32		2	10
	24		2	0
	18		1	8
	12		1	0
Iron Guns	42-Pounders		14	0
	32		10	11
	24		8	0
	18		6	0
	12		4	0
	9		3	0
	6		2	0
	4		1	6
	3		1	0
Brass Guns	12-Pounders,	Heavy	4	0
		Light	3	0
	9		3	0
	6-Pounders,	Heavy	2	0
		Light	1	8
	3-Pounders,	Heavy	1	0
		Light	0	12

The service charge is now used for firing spherical case-shot.

HOWITZERS.

Charges for firing and bursting common Shells.

		Charge	Burstg.
		lb. oz.	lb. oz.
Howitzers	10-Inch	7 0	2 10
	8-Inch	3 8	1 14
	5½ Heavy	2 0	0 10
	24-Pounder	2 8	0 10
	12-Pounder	1 8	0 5

The charge for carronades is usually one-twelfth the weight of the shot. The highest is one-eighth, and the lowest one-sixteenth.

By the experiments made at Woolwich in March 1801, it is recommended, that when cylinder powder is used on service, the charges of field ordnance with round-shot, shall be reduced to the usual quantities for case-shot. The same experiments recommend, that the thickness or length of the wood bottom be varied, in order to change the position of the shot, and thereby save the bore; and that the paper cap, which is usually thrown away on service, shall be put over the shot before it is introduced into the piece.

For charges for small arms, see the word *Cartridges*.

Charges of French Guns in French Weights.

	lbs.		
24-Pounders	8	Siege	
16-Pounders	5½	Siege	
12-Pounders	4	Field	¼ less for Case Shot.
8-Pounders	2½	Field	¼ less for Case Shot.
4-Pounders	1½	Field	¼ less for Case Shot.

CHEVAUX DE FRIZE.—The *body* or *beam* of a chevaux de frize is generally made 9 feet long, and 6 inches square, and weighs 41lbs. The *spears* are 33 in number, weighing 2lb. each, are 3 feet long, and 1¼ inches square. They are placed 9½ inches asunder.

COMPOSITION.—For the Composition of fuzes, portfires, tubes, carcasses, see these words:

Composition for Kitt.

	lbs.
Rosin	9
Pitch	6
Bees' wax	6
Tallow	1

For *Fire Balls*, 1794.

	lb.	oz.
Rosin	5	8
Sulphur	3	0
Alum powder	1	8
Starch, ditto	0	8
Saltpetre	4	6
Mealed powder	8	0
Linseed oil	¼ pint	
Oil of Spike	1 pint	

Bengal

Bengal Lights.

First Composition.

	lbs.	oz.
Saltpetre	7	0
Sulphur	1	12
Red orpiment	0	8

Second Composition.

	lbs.	oz.
Salpetre	2	4
Sulphur	0	8
Antimony	0	4
Orpiment	0	1½

Light Balls.

Nitre	40 parts.
Sulphur	15
Antimony	3
Pitch	3

This composition to be carefully fused, and cast into the shape of balls, which, when cold, will be sufficiently hard to be fired from a small mortar.

Composition for *Suffocating Pots.*

Sulphur	6 parts.
Nitre	5

This composition, when intimately mixed, to be rammed into wooden boxes, and primed in the usual way.

This composition will answer for fumigation.

Chinese or *White Lights.*

Nitre	from 50 to 60 parts.
Sulphur	16 to 20
Antimony	5
Orpiment	8 to 10

For *Smoke Balls.*

	lbs.
Corned powder	10
Saltpetre	2
Pitch	4
Sea-coal	3
Tallow	1

For *Fire-Hoops, Fire-Arrows,* and *Fire-Lances.*

	lbs.	oz.
Mealed powder	1	0
Saltpetre	3	0
Flour of sulphur	0	8
Linseed oil	½pint.	

Composition to fill cases for *setting fire to Fascine Batteries.*

	lb.	oz.
Mealed powder	1	4
Saltpetre	6	0
Sulphur	1	8

Black

Black Lead Lacquer for the *Cylinders of Ordnance.*

	lb.	oz.
Black-lead (Cumb.)	24	4
Linseed oil, by wt.	80	4
Red lead	6	12
Lamp black	0	12
	112	0

The ingredients to be well ground in oil, and afterwards boiled over a slow fire for some time, taking care no damp falls into the vessels, which would cause an explosion.

Anti-corrosion for the *exterior of Iron Ordnance.*

	lb.	oz.
Anti-corrosion	57	8
Grant's black	5	8
Red lead	4	8
Linseed oil by wt. ..	43	0
Spirits of turpentine	1	8
	112	0

When mixed it is fit for use; and, as it grows hard, no more should be made than can be used.

Other Lacquers for coating Shots or Shells.

No. 1.	lb.	oz.
Black lead	1	0
Red lead	0	4
Raw or unboiled linseed oil	1 qrt.	

No. 2.	lb.	oz.
Grant's black	1	0
Red lead	0	2
Oil as before........	½ pint	

No. 3.	lb.	oz.
Coal tar............	2	0
Red lead	0	2

All dry compositions must be well mixed; first by the hands, and then passed several times through fine hair sieves, that the ingredients may be thoroughly incorporated. In mixing compositions which require fire, the greatest precautions are necessary; particularly in those where gunpowder enters. The dry parts of the composition may in general be mixed together first, and put by degrees into the

the cauldron, where the other ingredients are fluid, being well stirred all the time of putting in. When the dry ingredients are inflammable, the cauldron must not only be taken off the fire, but the bottom must be dipt in water, to prevent the possibility of accidents while mixing them.

R. Lab.

CONVOYS.—A waggon with four horses occupies about sixteen paces; a mile will therefore hold about 117 waggons; but allowing a short distance between each waggon in travelling, a mile may be said to contain 100 waggons. Waggons in convoy may travel from one to two miles per hour, according to the roads and other circumstances. A great object in convoy is to preserve the horses as much as possible from fatigue. For this purpose, if the convoy amounts to many hundred waggons, they must be divided into divisions of not more than 500 each. Should it consist of thousands, it will be adviseable to divide them into *grand* divisions, and then again into subdivisions of 500 each: by this means, and the time of departure being calculated by the following rules, each division may remain at rest, till just before its time of movement; and which will prevent the necessity of the latter part of a large convoy being harrassed for a considerable time before its turn to move.

Rule 1:—*To find the time in which any number of waggons*

gons may be driven off:—Divide the number of waggons by 100, and multiply by the time of travelling one mile.

Rule 2.—*To find the time in which any number of waggons will drive over any number of miles:*—To the time they take in driving off, add the time any one of the waggons takes to travel the distance.

The different divisions of the convoy should be numbered, and obliged each day to change the order of their marching.

Whenever the progress of a train of waggons is arrested by the breaking down of any one of them, or other delay, all the waggons in the rear of the stoppage should immediately drive up into the first open space, to as great a number as the open space will hold; this keeps the convoy together, and better under the care of the escort.

The escort for a convoy should be divided into front, centre, and rear guards; besides the divisions for the flanks, which should never be beyond musquet-shot, or at most 400 yards from each other. The whole escort should never be so separated that they could not be collected in an hour. Under proper precaution against an enemy, a convoy of any size cannot travel more than five or seven miles per day.

TEMPLEHOFT.

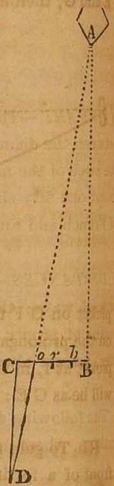
DIS.

DISPART.—The dispart of a gun is the half difference between the diameter of the gun at the base ring, and at the swell of the muzzle. The general dispart of all guns is about one fifty-sixth part of their length. See the disparts of French and English guns under the word *Tangent Scale.*

DISTANCES.—Inaccessible distances may be found several ways; the most correct of which of course is by means of proper mathematical instruments; which, however, are not always to be had in the field.

The following different methods are laid down by several authors, where instruments cannot be had.

Fig. 1.



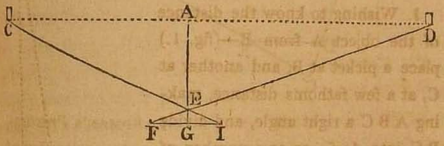
I. Wishing to know the distance of the object A from B—(fig. 1.) place a picket at B, and another at C, at a few fathoms distance, making A B C a right angle, and divide B C into 4, 5, or any number of equal parts: make another similar angle at C, in a direction from the object, and walk along the line C D till you bring yourself in a line with the object A, and any of the divisions (say *o*) of the line B C. Then, as C *o*: C D:: B *o*: B A.

VAUBAN.

II. To gain the distance between two objects C and D (fig. 2.) from any point A, taken in the line C D, erect the perpendicular A E: on which set off from A to E, 1 or 200 feet, more or less, according to the distance between the points C and D: set off from E to G in the prolongation A E, one-eighth or one-tenth of A E; at G raise the perpendicular

dicular G F, and produce it towards I; plant pickets at E and G, then move with another

Fig. 2.

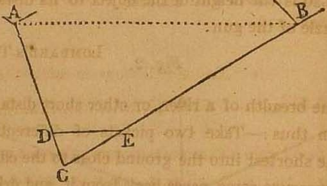


picket on G F till it becomes in a line with E and D; and on the prolongation of the perpendicular F G, place another picket at I, in the line with E and C: measure F I, and it will be as G E : A E : : F I : C D.

III. To gain the inaccessible length A B, (fig. 3.) of the front of a fortification, plant a picket at C, from whence both points may be seen: find the lengths C A and C B by the method just given, (No. 1.); make C E one-fourth, or any part of C B, and make C D bear the same proportion to C A: measure D E, then it will be as C D : D E : : C A : A B.

Fig. 3.

Fig. 3.



LANDMAN'S *Practical Geometry on the Ground.*

Note.—Nearly after the same manner may be ascertained the distance from B to A, when the point B is accessible: for having measured the line C B, and made the angle CED equal to C B A, it will be, as C E : D E : : CB : B A.

IV. The distance of a battery, or other object, may be ascertained by the tangent scale on the breach of a gun.—It is, however, necessary in this case to know the height of the object, the distance of which is required.—Lay the gun by the upper line of metal for the *top* of the object, then raise the tangent scale till the top of the scale and the notch at the muzzle are in a line with the bottom of the object, and note what length of tangent scale is required: then say, as the length of the scale above the base ring of the gun

gun is to the length from the base ring to the swell of the muzzle, so is the height of the object to its distance from the muzzle of the gun

LOMBARD'S TABLES.

V. The breadth of a river, or other short distance, may be taken thus:—Take two pickets of different lengths, drive the shortest into the ground close to the edge of the bank; measure some paces back from it, and drive in the other till you find, by looking over the tops of both, that your sight cuts the opposite side.—Then pull up the first picket, measure the same distance from the second, in any direction the most horizontal, and drive it as deep in the ground as before: consequently, if you look over them again, and observe where the line of sight falls, you will have the distance required.

TEILK.

VI. The following simple method of ascertaining the breadth of a river may be sufficiently correct for some cases:—Place yourself at the edge of one bank, and lower one corner of your hat till you find the edge of it cuts the other bank; then steady your head, by placing your hand under your chin, and turn gently round to some level spot of ground, and observe where your eyes and the edge of the hat again meet the ground; your distance from that point will be nearly the breadth of the river. TEILK.

VII. Distances ascertained by the difference between the true and apparent level.

See *Levelling*.

VIII. Distances measured by sound.

See *Sound*.

IX. The following simple micrometer may be so usually applied to military purposes, that I shall extract it verbatim from the Philosophical Transactions for 1791, where it is described by Cavallo. This micrometer consists of a thin and narrow slip of mother of pearl, finely divided, and placed in the *focus* of the eye-glass of a telescope, just where the image is formed.—It is immaterial whether the telescope be a reflector or a refractor, provided the eye-glass be a *convex* lens, and not a *concave* one, as in the Galilean construction. The simplest way to fix it, is to stick it on the diaphragm, which generally stands within the tube, and in the focus of the eye-glass. When thus fixed, if you look through the eye-glass, the divisions on the scale will appear very distinct, unless the diaphragm is not exactly in the focus; in which case the scale must be placed exactly in the focus, by pushing the diaphragm backwards or forwards, when this is practicable; or else the scale may be easily removed from one surface of the diaphragm to the other, by the interposition of a circular bit of paper or card, or a piece of sealing-wax.—This con-

struction

struction is fully sufficient when the telescope is always to be used by the same person; but when different persons are to use it, then the diaphragm, which supports the micrometer, must be so constructed as to be easily moved backwards or forwards, though that motion need not be greater than about the tenth or eighth of an inch.—This is necessary, because the distance of the focus of the same lens appears different to the eyes of different persons; and, therefore, whoever is going to use the telescope for the mensurations of an angle, must first unscrew the tube which contains the eye-glass and micrometer, from the rest of the telescope, and, looking through the eye-glass, place the micrometer where the divisions of it may appear most distinct to his eye. The mother of pearl scale may be about the 24th part of an inch broad; its length is determined by the aperture of the diaphragm; its thickness that of writing paper. The divisions on it may be the 200th of an inch, which may reach from one edge of the scale to about the middle; and every fifth and tenth division may be a little longer, the tenths going quite across. When the telescope does not magnify above 30 times, the divisions need not be so minute.—For the sake of those not conversant in trigonometry, the following is an easy method of determining the value of the divisions on the scale:—Mark upon a wall or other place the length of 6 inches; then place the telescope before it, so that the 6 inches be at right angles to it, and exactly 57 feet 3½ inches distant

distant from the object-glass of the telescope.—This done, look through the telescope, and observe how many divisions of the micrometer are equal to it, and that same number of divisions will be equal to half a degree, or 30; and this is all that need be done to ascertain the value of the scale.—The reason on which it is founded is, that an extension of 6 inches at the distance 57 feet, 3½ inches, subtends an angle of 30, as is easily calculated by trigonometry.—To save the trouble of calculation, a scale may be made, requiring only inspection. Thus, draw a line equal to the diameter of the field of the telescope, and divide its under side into the same number of parts as are on your micrometric scale, and, by the above operation on the wall, having determined the value of 30, which we will suppose to correspond with 16 divisions on the scale, mark 30′, on the opposite side of the line, opposite 16 on the lower, 15 opposite 8, and so on.

By the following table, the results may be ascertained by inspection only: thus, suppose an extension of 1 foot is found by the table to subtend an angle of 22′, the distance will be 156·2: and suppose at the distance of 171·8 an object subtends an angle of 20′, its height will be found to be 1 foot: or, suppose an object of 6 feet high to subtend an angle of 20′, the distance is 1030·8, by multiplying 171·8 by 6.

Table

Table of Angles subtended by 1 *Foot, at different Distances.*

Minutes.	Distances in feet.	Minutes.	Distances in feet.	Minutes.	Distances in feet.	Minutes.	Distances in feet.
1	3437·7	16	214·8	31	110·9	46	74·7
2	1718·9	17	202·2	32	107·4	47	73·1
3	1145·9	18	191·0	33	104·2	48	71·6
4	859·4	19	180·9	34	101·1	49	70·1
5	687·5	20	171·8	35	98·2	50	68·7
6	572·9	21	162·7	36	95·5	51	67·4
7	491·1	22	156·2	37	92·9	52	66·1
8	429·7	23	149·4	38	90·4	53	64·8
9	382·0	24	143·2	39	88·1	54	63·6
10	343·7	25	137·5	40	85·9	55	62·5
11	312·5	26	132·2	41	83·8	56	61·4
12	286·5	27	127·3	42	81·8	57	60·3
13	264·4	28	122·7	43	79·9	58	59·2
14	245·5	29	118·5	44	78·1	59	58·2
15	229·2	30	114·6	45	76·4	60	57·3

DOLPHINS or handles are cast to all heavy brass guns. The proper position for them is such, that when the gun is suspended by them, the breach may preponderate eight times the weight of the shot more than the muzzle.

DRAG-ROPES with	5 pins,	6 lbs.	8 oz.	weight	21 ft.	length.
	4	5	6		13	
	3	5	0		12	

EMB

EMBARKATION.

1. *Of Ordnance and Stores.*—The first thing necessary is to prepare a list of all the articles to be embarked, with the weight of each. This list must have a large column for remark. The tonnage required for bulky articles will be generally ⅓ more than their actual weight; but the tonnage of ordnance, shells, shot, &c. will be equal to their weight. If vessels be paid according to the tonnage they carry, the masters will of course stow away as much as the ships will hold; but, if by the voyage, they will be averse to loading their ships too much: a naval officer should therefore always attend to see that the ships are properly stowed.

Ordnance and stores may be embarked either for the purpose of merely transporting them to another situation, or for a military expedition. In the first case, each ship must be stowed with as much as it will carry, and every article that relates to one particular species of service or ordnance, must be put on board the same ship; that in case one ship be lost, the others may remain in themselves complete. This principle must, of course, be likewise attended to in an embarkation for an expedition; but a more particular distribution must take place of the stores when

on

on board. With each piece of ordnance must be placed every thing necessary for its service; its side arms, carriage, limber, ammunition, &c. so as to be readily come at, when required to be disembarked. If it be an embarkation of ordnance, &c. for a siege, not only every thing necessary for the service of the pieces of ordnance should be arranged with them, but also every thing necessary for the construction of the battery on which they are mounted. It will be advisable in this case, to put different natures of ordnance in the same ship, in proportion according to the service required of them. In general, it will be best to put the heavy articles in first, and every thing that is light, easy to be removed, or likely to be first wanted, on the top. Previous to embarkation, the guns, carriages, waggons, &c. must be dismounted, but first numbered as follows; and the number of each article marked in the list, in the column of remarks. Give each piece of ordnance and its carriage the same number. Give the ammunition and other carriages different numbers from the ordnance carriages. Then give every limber, whether of ordnance carriage, ammunition carriage, or waggon, the number of its respective carriage. If for a simple transport, arrange the small stores, side arms, &c. according to their several natures; but if for an expedition, every thing belonging to each particular piece of ordnance must be collected together, and the cases or chests in which they are put, marked with the number of the piece of ordnance to which they belong, their natures

and

and description. If there be any doubt of the different parts of the carriages being made with that uniformity so essentially necessary, every part which is separated must bear the number of its carriage. This precaution, at any rate, may be a good one, if the same vessel contain different natures of ordnance or carriages.

The axle-trees need not be taken off the carriages, if the vessels be of a sufficient size to admit them when fixed, as they are not easily re-placed without workmen and a tedious operation. When a carriage is dismounted, all the small articles, such as elevating-screws, linch-pins, drag-washers, capsquares, &c. must be carefully collected, and secured in a box, marked with the description of stores, and number of the carriages to which they belong. All carriages or waggons embarked with their axle-trees fixed, must be arranged in the ship side by side, and alternately front and rear, that their axle-trees may not interfere with each other, and take too much room. Every transport or other vessel employed in carrying troops or stores for an expedition, should be numbered on the quarters and on the bows, with figures as large as 2 or 3 feet, and on the sails, that they may be known at a distance. The number of the ship, her name and tonnage, and the master's name, must be entered in the list of the stores which she carries.

In disembarking ordnance and stores, they must be landed exactly, in order, the reverse of what they were shipped. The carriages and waggons must be mounted as

soon

soon as possible, and every nature must be arranged as far from the shore as possible, to prevent confusion. If the disembarkation take place in the presence of an enemy, the vessels of course must be loaded accordingly: and the field ordnance, with their carriages, ammunition, &c. must be so arranged as to be first landed, and with the greatest ease possible. In this case, the entrenching tools must also be kept in the greatest readiness.—*Aide Memoire.*

2. *Of Troops.*—All transports taken into His Majesty's service, are under the direction of the Transport Board, and of their agents, at the different ports at home and abroad. No troops or other persons can be put on board them, or victualled, but by an order from this Board, or one of its agents. Troops embarked on board transports or ships of war (except as marines) are only allowed $\frac{2}{3}$ of a seaman's allowance of provisions.—(See the word *Ration.*) It is therefore necessary to divide the men into messes of 6 each. Six women to 100 men embarked on foreign service, are allowed provisions; and 10 women to 100 men on home service. The berths on board transports are usually made 6 feet square, and each admits 4 men at a time; but agreeable to the regulations for the army for 1799, one third of the men are always to be on deck; therefore 6 men (or one mess) are told off to each berth, $\frac{1}{3}$ of whom are always on the watch. The commanding officer of the troops on board a transport, has a right to peruse the charter-party of the ship, which points out every different article,

article, as firing, candles, boats, utensils, &c. which the ship is engaged to find for the use of the troops on board. It likewise expresses the part of the ship allotted to the officers, to the master, the mate, and the agent, should there be one on board.

EXERCISE of Artillery—with 9 men to a field gun.

When 15 men are attached to the service of a gun in the field, they are numbered from 1 to 15; but when the gun is not to be advanced by men, the last 6 numbers are left out, and the remaining 9 men are numbered from 1 to 9. The exercise of field guns of a heavy nature varies but little from the light ones. The different duties done by the men attached to the one, should, as nearly as possible, be kept up at the other: as thereby is prevented that confusion which must arise when men removed from a light gun to a heavy one, change their numbers, though their duties at each be the same. The following will be the position of 9 men, for field ordnance of all natures, in the

1. *Line of March.*

Numbers 2, 4, 6, and 9, on the left of the gun; 3, 5, 7, 8, and 1, on the right; numbers 2 and 3 opposite the muzzle of the gun; 4 and 5 opposite the breech; 6 and 7 opposite the trail; 8 opposite the axle-tree of the limber; 1 opposite the shafts.

2. *Position and Duties of 9 Men, when prepared for Action.*

Light Guns.—2 sponges, 3 loads, 4 serves the vent, 5 fires, 1 commands, 6 carries the match and water bucket, 7 serves 3 with ammunition from 8, who carries a cartouch and a pair of drag-ropes; 9 has charge of the limber and carries a cartouch.

Positions.—2 outside the right wheel; 3 outside the left wheel; 4 clear of the rear of the right wheel; 5 clear of the left wheel, both in a line with the vent; 1 on the left of the hand-spike; 6 on his right, clear of 4; 7 covers the left wheel, 5 yards in the rear; 8 covers the right wheel, 10 yards in the rear. The limber is 25 yards directly in the rear of the gun.

Heavy Guns.—This is the same as with the light guns, except that 3 assists 2 to ram home, if necessary.

Howitzers.—Positions are the same as the heavy guns, but the duties different.—2 sponges, uncaps the fuze, and puts in the shell; 3 takes the sheep-skin out of the piece, lays it on the ground, with the woollen side up, loads with cartridges, wipes the bottom of the shell, (when 2 holds it up) puts in the sheep-skin again, and pulls it out with his left hand, on the word *Ready*—he stops the muzzle with it immediately that the piece is fired; 4 serves the vent; 5 fires; 1 commands; 6 carries the match and bucket; 7 serves 3 with cartridges from a cartouch; 8 serves 2 with

M shells

shells from the limber, which he lays on the sheep-skin; 9 attends the limber. As, from unavoidable accidents, the number of men attached to a gun, may be reduced, it will be necessary, if the vacancies happen amongst those doing the most essential duties, to immediately re-place them by those doing the most subordinate duties.

The

The following Method of Distributing the Duties amongst a smaller Number of Men, will be equally applicable to all Natures of Field Ordnance.

No. of Men.	Nature	Numbers retained.									The vacancies, how supplied.
9	Gun or Howit^{r}	2	3	4	5	1	6	7	8	9	complete.
8	Gun or Howit^{r}	2	3	4	5	1	7	8	9		N$^{o.}$ 6 being dropt N$^{o.}$ 1 does his duties.
7	Gun....	2	3	4	5	1	7	9			N$^{o.}$ 8's pouch is laid on the ground; 7 carries it when moving.
	Howit^{r}..	2	3	4	5	1	8	9			N$^{o.}$ 3 serves himself with cartridges.
6	Gun or Howit^{r}	2	3	4	1	7	9				N$^{o.}$ 4 serves the vent with his left hand, faces about and fires.—Tube box on left side.
5	Gun or Howit^{r}	2	3	1	7	9					N°. 1 does all the duties of 4, as in the last change, his own duties, and those of 6.
4	Gun or Howit^{r}	2	3	1	9						N$^{o.}$ 3 fetches his own ammun^{n} N$^{o.}$ 2 serves his own shells.
3	Gun or Howit^{r}	2	1	9							N$^{o.}$ 2 serves and loads all the ammunition.—N$^{o.}$ 2 and 9 must change duties occasionally.

 3. To

3. To limber up—Light Guns and Howitzers.

The whole of the men face towards the gun; 1 unships his traversing handspike; the limber is brought up rather to the right of the gun, and then turned to the left about; 6 and 7 raise the trail, and place it on the limber, in which they are assisted by 2 and 3 bearing down on the muzzle, and 4 and 5 at the wheels; 1 keys the limber.

Heavy Field Guns, or Howitzers.—The only difference from the above is, that 4 and 5 assist 6 and 7 to raise the trail, and 8 and 9 stand to the gun wheels.

4. To unlimber—Light Guns and Howitzers.

The whole face towards the gun; 1 unkeys the limber; 6 and 7 lift the trail off the pin-tail, and set it on the ground, in which they are assisted, as in limbering up, by 2, 3, 4, and 5; 1 ships the traversing handspike, and the whole assume the position for action.—The limber is taken 25 yards to the rear, and there turned to the left about.

Heavy Field Guns and Howitzers.—The same as the light ones, except that 4 and 5 assist 6 and 7 to raise the trail, and 8 and 9 stand to the gun wheels.

It must be understood, that simply to *limber up*, or to *unlimber*, means that the gun is to be placed upon its limber, or lifted off, without changing its direction: but guns may be limbered up to the *front*, to the *right*, or to the *left*, according

according as it is intended to advance in any one of those directions; and unlimbered to the *rear* to prepare for action to the *front*, to the *left* for action to the *right*, and to the *right* for action to the *left*.—To limber up, or to unlimber, in any of these situations, is exactly the same as those already given, except that in the first, previous to limbering up, the trail is thrown round by No. 1, assisted by 6, if necessary, into the direction specified by the word of command, and the limber is brought up to that side to meet it; and in the second, the trail, after being taken off the limber, is carried round to the *rear*, *right*, or *left*, according as the word of command expresses, before it is put to the ground, and the limber goes round to the rear of the gun.

It must be here remarked, that the *front* of a gun, or line of guns, or column of guns, is that to which the men at the gun front, without any respect to the situation of the gun or carriage. The trail of the carriage, when moved round to the rear, or the contrary, whether in limbering up or unlimbering, must always be carried round to the *right*, and the limber, when brought up to advance or retire a gun, must always be brought up on the *right* side, and go off on the *left*; and whenever the limber is turned about it must be to the *left* about. By attending to these precautions the greatest confusion is avoided.

Exercise with Garrison Guns.

6 *Men.*

1 points and commands.
2 spunges, runs up, elevates
3 loads, runs up, and elevates.
4 serves the vent, runs up, traverses, and primes.
5 runs up, traverses, fires.
6 brings cartridges.

5 *Men.*

1 points and commands.
2 spunges, runs up, elevates.
3 brings cartridges, loads, runs up, and elevates.
4 serves vent, runs up, traverses, and primes
5 runs up, traverses, fires.

4 *Men.*

1 runs up, points, and commands,
2 spunges, runs up, traverses and elevates
3 brings cartridges, loads, elevates, traverses, and fires.
4 serves the vent, runs up, and primes

3 *Men.*

1 serves the vent, runs up, points, primes, and commands.
2 spunges, runs up, elevates, and traverses
3 runs up, brings cartridges, loads, elevates, traverses, and fires.

$4\frac{1}{2}$ *or* $5\frac{1}{2}$ *Inch Mortar.*

3 *Men.*

1 points, elevates, and commands.
2 spunges, runs up, traverses, brings shells, and puts them in.
3 brings cartridges, loads, serves the vent, runs up, primes, and fires.

2 *Men.*

1 serves the vent, runs up, brings cartridges, loads, points, fires, and commands.
2 spunges, runs up, brings shells, puts them in, traverses, and primes.

8-*Inch*

8-Inch Mortar and Howitzer.

5 *Men.*

1 points and commands.
2 runs up, spunges, wipes the bottom of the shell, uncaps the fuze, and takes out and puts in the sheep-skin.
3 runs up, brings cartridge, loads, and puts in shell.
4 runs up, serves the vent, and traverses.
5 primes, brings up shells, traverses, and fires.

10-Inch Mortar & Howitzer.

5 *Men.*

1 points, commands, and serves the vent.
2 runs up, spunges, wipes the bottom of the shell, uncaps the fuze, assists to put in shell, puts in and takes out sheep-skin.
3 runs up, brings cartridge, loads, and assists to put shells in
4 runs up, assists 5 to bring up shell to the right of the mortar, traverses, and primes.
5 runs up, assists 4 to bring up shell, traverses, and fires.

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7 *Men to a* 13-*Inch Mortar.*

1 points and commands.
2 runs up, spunges, wipes bottom of the shell, uncaps fuze, traverses, and puts in and takes out the sheep-skin.
3 runs up, brings cartridge, loads, assists to put in the shell, and traverses.
4 runs up, serves the vent, traverses, and primes.
5 runs up, traverses, and fires.
6 & 7 assist to run up, bring up the shell on the right of the mortar, and assist to put it in.

Exercise of the Gin.

The complement of men for a gin is usually 1 non-commissioned officer and 10 men; they are numbered from 1 to 11, the non-commissioned officer being 1.

To carry a Gin.

1 commands, 2 and 3 carry the pry-pole, 4 and 6 the right cheek, 5 and 7 the left, 8 the windlass and fids, 10 and 11 the blocks and tackles, 9 the handspikes, &c.

To set up a Gin.

2 and 3 put a common handspike through the ring, near the foot of the prypole, at which they lift; 4 and 5 steady the cheeks, by placing each a handspike against the lower cross-bar; 6 and 8 lift the right cheek; 7 and 9 the left cheek; 1 gives directions.—The tackles must be hooked on before the gin is raised; then 10 and 11 double man the handspikes with 2 and 3.

To work a Gin.

2 and 4 man the right handspikes of the gin; 3 and 5 the left; 6, 7, 8, and 9 hold on the fall, and pull in the slack; 10 and 11 steady the gun, 10 at the muzzle, 11 at the breach.—The tackle hook must be fixed directly over the dolphins, if any, or a little behind the trunnions.

In heaving, when the ends of the handspikes of 2 and 5

come

come as low as their knees, 3 and 4 put theirs into the upper holes of the windlass, and 3 gives the word *Fetch*, upon which 2 and 5 clear their handspikes from the windlass, and 2 gives the word *Heave:* 3 and 4 then bear down their handspikes, and remain fast, till 2 and 5 having taken their fresh purchase, 2 gives the word *Fetch*, when 3 and 4 clear their handspikes, and 3 gives the word *Heave;* and so on alternately, till the gun is at its proper height, when the handspikes in the upper holes are made to rest against the upper cross bar, and 6 makes fast the fall to the lower cross bar; and, if required to lower the gun, eases the fall off from the windlass; 2, 3, 4, and 5 move the carriage, as required, under the gun.

The gins of the new construction have a small racket-wheel, and dropping paul, on the roller, and the word *heave* is only used in lifting.

Exercise of the Sling Cart.

The men for the service of the sling cart are numbered from 1 to 7; the non-commissioned officer being No. 1.—No. 2 and 3 sling the gun.—The gun must be laid with one trunnion touching the ground, and the sling passes diagonally round the gun; being before one trunnion, and behind the other; and that end of the sling which goes round the lower side of the gun must be the end to be acted on by the windlass; as by that means the trunnions become horizontal when the gun is raised.—No. 2, 3, and

6,

6, man the right lever; 3, 5, and 7, the left lever, and upon the word from the non-commissioned officer they heave together; the non-commissioned officer then directs *left-hand lever hold on, right lever fetch;* the right lever takes a fresh purchase; then, *right lever hold on, left lever fetch;* the left lever takes a fresh purchase; they then heave together again. When the gun is high enough, 1 puts in the pall; 2 and 3 take out the levers, and put in the prypole; 4 and 5 raise the breach of the gun with two common handspikes, and 6 and 7 lash it to the prypole: 2 and 3 then lay their levers alongside the prypole, and 4 and 5 their handspikes on the top of them, which 6 and 7 lash all fast together.

To mount an 18 *or* 24-*Pounder on a travelling carriage, without a gin.*

Lash a beam of wood, 4 inches square, across the vent field of the gun, run the wheels of the carriage up close to the beam, and lash the two ends to them, taking care that the spokes are even, and that the beam projects 6 inches beyond each wheel: lift up the trail of the carriage perpendicularly, and keep it in that position with drag-ropes until another beam of the same dimensions as the former is lashed behind the carriage, passing through and resting on the spokes of the wheels, close to the fellies; the trail by this means becomes a lever. The detachment which held on the drag-ropes in front, are now passed to the rear, and

haul

haul down the trail, by which means the gun will be half mounted, the muzzle resting on the ground. Unlash the beam underneath the carriage, lift up the trail again, and 9 takes a fresh purchase, which will bring the gun home to the trunnion holes. If a small roller of wood be placed in front of the cap-square bolts, the trunnions will slide much easier into the trunnion holes, and the gun in mounting will not jam in the cheeks of the carriage at the breast trunsom.

A long gun may be mounted by sinking the muzzle in the ground until the trunnions are the same height as the trunnion holes of the carriage. The trail is then raised perpendicular, run up to the gun, the cap-squares keyed, and the trail hauled down; or the carriage may be inverted over the gun when skidded, and hauled back into its proper position by main force. This method is apt to endanger the wheels of a travelling carriage, if the gun is heavy.

Exercise of the Devil Carriage.

Seventeen men are required for this purpose: from 2 to 9 are drag-rope men; 2 and 3 keep the rope stretched out, to prevent the perch falling; 4 to 9 lift up the breast of the carriage as far forward as the neck astragal; 11 puts a rope round the hind axle-tree of the gun carriage, passes it through the ring on the perch of the devil carriage, and brings it through the spokes of the wheel, to hold on; 16 and 17 take the second ropes, which are made fast to a ring

ring at the end of the perch, and take a purchase through the spokes and over the nave of the limber-wheel; at the word *Hold on* they take a second turn round the nave. At the word *Unlimber*, 10, 11, 12, 13, 14, and 15, lift up the perch; 14 and 15 unkey the pintail; 12 and 13 unhook the draft-chain; No. 1 lifts up the shafts, and secures the limber-wheels with four small coins; 10 slings and un-slings the guns, leaving four links spare, with the back of the hook to the gun. After the gun is slung, and the carriage limbered up, 12, 13, 14 and 15, take the two 8 feet levers, and raise up the breach of the gun; and, at the same time, 10 and 11 take the two ends of their rope, pass them under the cascable, over the perch, and lash the breach of the gun securely; 11 makes fast the trail of the carriage to the perch with the rope that comes round the hind axle-tree; 8 and 9 bring the first ropes forward between the trucks and the breast of the carriage, and lash them fast round the fore axle-tree; 6 and 7 then take the two spare ropes, and lash the gun-carriage to the devil-carriage, by passing them round the fore axle-tree, and under the bolster of the devil-carriage. The handspikes, levers, &c. to be lashed on between the gun and devil-carriage. No. 1 commands the whole.

Pontoon Exercise.

The men required for the service of a pontoon are 14, and a non-commissioned officer: they are numbered from 1 to 14.

To

To unlimber a pontoon, 1 and 2 unlash the ropes at the front rings; 3 and 4 unlash the second; 5 and 6 the third; 7 and 8 the fourth, behind the wheels; 9 and 10 the fifth; 11 and 12 the rings at the end of the carriage; 13 and 14 lash the cable and anchor; 1 and 2 lash the carrying pole in front; 11 and 12 the same abaft; 1, 3, 5, carry on the right; 2, 4, 6, on the left, in front; 7 and 8 lift at the front rings in dismounting, and at the rear in mounting; 9, 11, 13, carry on the right; 10, 12, 14, on the left, in the rear; 15, or non-commissioned officer, shifts the mounting bars. After the boat is dismounted, it must be turned on its bottom; 1 and 14 mount the carriage, and take off the chesses; 2 and 3 take away the first chess; 4 and 5 the second; 6 and 7 the third; 8 and 9 the fourth; 10 and 11 the 5th; 12 and 13 the 6th; 1, 2, 11, and 12, unkey the baulks, which, with the gang-boards, are to be taken off by the men of the boat.

Horse Artillery Exercise.

A troop of horse artillery had attached to it, during the war, five light 6-pounders and one 5½-inch howitzer. The complement of men for the service of each piece is, 2 non-commissioned officers and 6 gunners, mounted, and 2 gunners on the limber.

Gun detachment, mounted, { 4, 12, 5, 1, sen. non-com. officer,
7, 13, 6, 11, jun. non-com. officer,
2, 3, on the gun limber,
14, 15, on the amm. waggon do.

No. 2 sponges; 3 loads; 4 serves the vent; 5 fires; 1 commands; 7 is twelve yards in the year, and carries a cartouch of ammunition; 6 stands five yards in the rear of the left wheel, and serves 3 with ammunition from 7.

Nos. 5, 6, 7, can best be spared; in which case 3 goes to the rear for ammunition; 1 does the duty of 5, in addition to his own.

In action, Nos. 11, 12, 13, continue mounted, in charge of horses.

No. 11 leads officers' and that of 1 to the rear.

12 those of 5 and 4.

13 those of 6 and 7.

A detachment reduced to 6, is mounted,

4, 12, 1,

7, 11, 6,

Limbers in action, 15 yards in the rear of the guns. Waggons in charge of the Quarter-Master-Serjeant, will follow the movements at such a distance as to be able to supply ammunition, when wanted.

Close order—half a horse's length.

Order—three horses' lengths, unless otherwise ordered.

Distance of files—six inches from boot top to boot top. *Close files*—boot tops touching without pressure. *Open files*—the breadth of a horse from boot top, &c.

Troop

Troop formed in line for inspection.

Detachments in line in front of their guns, leading driver, five horses' lengths from the rear rank; distance in line, from gun to gun, 19 yards. When the line breaks into column, with detachments on a flank, the intervals between the muzzles of the guns and the leading driver of the next will be two horses' lengths.

The officers, how posted—1 subaltern on the right of the troop, 1 on the left, and 1 on the right of the third sub-division, (or of the fourth, if it is named the sub-division of direction); the second captain, one horse's length in front of the centre. In column, the officers, &c. are on the pivot flank of their divisions.

Troop, how told off—From the right by detachments, guns and waggons; from the right by sub-divisions, divisions and half batteries. Six or four guns are generally termed a battery throughout the artillery service. Two guns, with their detachments, constitute a division; one a sub-division. The waggons are numbered off with their guns, but do not constitute a part of the sub-division. When acting with the guns, they conform to every movement. The detachments are told off by two's.

5, 1, } Right Two's
6, 11, }

4, 12, } Left Two's.
7, 13, }

Non-commissioned officers, how posted—in line, the Serjeant-Major two horses' lengths in rear of the right gun; in

in column, one horse's length on the reverse flank of the head of the column. The Quarter-Master-Serjeant, in line, dressing by the Serjeant-Major, in column, on the reverse flank of the rear sub-division. In action he has charge of the waggons.

The artificers, in line, two horses' length in rear of the centre of the troop. In all manœuvres, they are considered as detached.

Horse Artillery Manœuvres.

1. *A line halted, with detachments in front—the detachments ordered to the rear.*

Words of Command by

Comm^g Officer.	*Officers.*	*Nos. 1.*
Detachments, *Rear*, March,	Detachments, *Rear*, March,	Left about wheel,
	Forward,	of 2, 4, 5, Forward,
	Left about wheel,	of 2, 4, 5, Lt. about wh^l.
	Halt, Dress,	of 2, 4, 5, Halt, Dress,
	Front,	of 2, 4, 5, Front.

The pace is named by the commanding officer, and repeated by the officers before the word *March* is given. When a division has no officer, the non-commissioned officer commanding it repeats the words of command.

2. *A*

2. *A line—detachments in rear—detachments ordered in front.*

Commg Officer.	*Officers.*	*Nos. 1.*
Detachments, *front,*	Detachments, *front,*	Right incline,
March,	March,	
	Forward,	of 2, 4, 5, Forward,
	Left incline,	of 2, 4, 5, Left incline,
	Halt, Dress,	of 2, 4, 5, Halt, Dress,
	Front,	of 2, 4, 5, Front.

3. *A line, with detachments in the rear—detachments ordered to the left.*

Commg Officer.	*Officers.*	*Nos. 1.*
Detachments, *left,*	Detachments, *left,*	Left incline,
March,	March,	
	Front,	of 2, 4, 5, Front,
	Halt, Dress,	of 2, 4, 5, Halt, Dress,
	Front.	of 2, 4, 5, Front.

In throwing the detachment from the rear to the *right*, the detachments incline to the right.

4. *A line, with detachments in front—detachments ordered to the left.*

Comm Officer.	*Officers.*	*Nos. 1.*
Detachments, *left,*	Detachments, *left,*	Left about wheel,
March,	March,	
	Forward,	of 2, 4, 5, Forward,
	Lt. about wheel.	of 2, 4, 5, Lt. about whl.
	Halt, Dress,	of 2, 4, 5, Halt, Dress,
	Front.	of 2, 4, 5, Front.

When

When detachments are ordered from the front to the right, it is done on the same principle, and by wheeling to the right about instead of the left.

5. *A line, with detachments, on the right of their guns—detachments ordered on the left.*

Commg Officer.	*Officers.*	*Nos. 1.*
Detachments. *left,* March,	Detachments, *left,* March,	Right about wheel,
	Forward,	of 2, 4, 5, Forward,
	Rt. Whl forward	of do. Rt. wheel forward,
	Rt. Whl forward	of do. Rt. wheel forward,
	Halt, Dress,	of do. Halt, Dress,
	Front,	of do Front.

If detachments are ordered from the left to the right, it is done the reverse of the preceding. Instead of ordering the detachments, it is sometimes more convenient to order the guns in front, rear, or on a flank.

6. *A column of sub-divisions halted, with detachments on the left, (right in front)—detachments shifted to the right.*

Commg Officer.	*Officers.*	*Nos. 1.*
Detachments, *right,* March,	Detachments, *right,*	Right file,
	March,	of 2, 4, 5, Left Form
	Lt. Form, Halt,	of 2, 4, 5, Halt, Dress,
	Dress, Front,	of 2, 4, 5, Front.

In

In open columns of larger front than sub-divisions, the flanks are shifted as in line; in close column, of whatever front, by filing.

7. Increasing or diminishing the front of a column of march.

When a column of divisions is to be reduced to sub-divisions, it may be done by the sub-divisions next the pivot flank doubling behind those on the reverse flank, or by those on the reverse flank moving in front of those next the pivot flank, at an increased pace.

Commanding Officer.	*Officers commanding Divisions.*
Right form,	Left sub-divisions,
Column of sub-divisions,	Left shoulders forward,
	Right shoulders forward.

When sub-divisions are ordered to be formed to the left, officers commanding divisions give the word *Right shoulders forward*, naming the pace.

8. From a column of sub-divisions to form column of divisions.

Commandg. Officer.	*Officers commanding Divisions.*
Front form,	Rear sub-divisions,
Column of divisions,	Right shoulders forward,
	If in a walk—*Trot*,
	If in a trot—*Gallop*,
	Left shoulders forward,
	The original pace is then ordered.

9. *A*

9. *A line—detachments on the left—a column formed in rear of the right sub-division.*

Comg. Officer.	*Officers.*	*Nos. 1.*
Form column in rear of the right subdivision.	Ditto,	of 2, 3, 4, 5, 6, Right abou wheel,
	Ditto,	of 2, 4, 5, Forward,
		of 2, Left wheel, forward,
	Forward,	Left wheel, forward,
		Halt, Dress, Front,
	Rt. shoulders, forward,	of 4 and 5, Right shoulder. forward,
	Forward,	Forward,
	Lt. wheel forwd	of do. Left wheel, forward,
	Halt, Dress, Frt.	Halt, Dress, Front.

In all changes of position and manœuvre, immediately the caution is repeated by the officers, the commanding officer names the pace, or orders it to be sounded; and it is to be distinctly repeated by the officers before the word *March*, so that the whole may move together at that pace.

10. *A*

10. *A line—detachments on the left—column formed in rear of the left sub-division.*

Comg. Officer.	*Officers.*	*Nos. 1.*
orm column in rear of the left sub-division,	Ditto,	of 1, 2, 3, 4, 5, Right about wheel,
		of 5, Forward, right wheel.
		Forward, right wheel,
arch,	Ditto,	Forward, Halt, Dress, Front,
	Forward,	of 2, 4, Forward,
	Left shoulders forward,	of do. Left shoulders, forward,
	Forward,	Forward,
	Right wheel, forward,	Ditto, Right wheel, forward,
	Halt, Dress, Fr^t	Do. Halt, Dress, Front.

11. *A column of sub-divisions, right in front, with detachments on the left—a line formed to the left of the front.*

Comg. Officer.	*Officers.*	*Nos. 1.*
Left of the front form line,	Ditto,	of 2, Left wheel.
		of 3, 4, 5, 6, Right shoulders, forward,
		of 2, Forward, right wheel.
March.	Ditto,	Forward, Halt, Dress,
	Left shoulders forward,	of 4, 5, Left shoulders, forward,
	Halt, Dress,	Halt, Dress.

If the line is formed on sub-division 4, right in front, sub-divisions Nos. 1, 2, and 3 wheel to their right; No. 3 to the right again; 1 and 2 throw the left shoulder forward; and

and when the three sub-divisions are sufficiently in the rear of their markers, each of them wheels to the right about; Nos. 5 and 6 wheel to the left; 5 wheels again to the right, and 6 throws left shoulder forward.

12. *An open column of divisions, right in front, wheeled on the left into line.*

Comg. Officer.	*Officers.*	*Nos.* 1.
Left wheel into line,	Ditto,	Of the left sub-divisions,
March,	*March.*	Gun drivers, disengage to your right.
	Halt, Dress,	
Front,		

13. *In line—detachments in rear—action to the front.*

Comg. Officer.	*Officers*	*Nos.* 1.	*Nos.* 11.
Action to the front.	Ditto,	Dismount,	Limbers, March, Left reverse, Trot,
	Load,	Load,	Left reverse, Trot, Dress.

When the guns are brought into line, without any intention of commencing action immediately, the words of command are, *Unlimber, facing to your front:* they are not to be loaded without orders. Officers dismount in action except the second captain, whose post is in rear of the centre, unless he has charge of a division.

Detachments in front of their guns—action ordered to the front—men to be dismounted at once; and Nos. 11 give

the

the word to the limber and led horses, *Left reverse;* and, when sufficiently in rear, *Left about wheel.*

Detachments on the left—action ordered to the front—Nos. 11, immediately the guns are unlimbered, give the word *Right about wheel, forward;* and when sufficiently in rear, *Right about, halt, dress.*

Detachments on the right—the words of command are the reverse.

Retiring in line—detachments ought, in most cases, to be on the left of their guns, never in front.

Retiring in line—detachments on the left—action ordered to the rear—Nos. 11 move off, as soon as possible, with the led horses and limbers, and, when a sufficient distance, order, *Right about;* if the detachments are on the right, they are put *Left about.*

Action ordered to the rear—detachments being in rear—Nos. 11 incline to the right, clear of the guns, and then follow the limbers; when at a proper distance, *Left about.*

Action ordered to the right, when marching in column of sub-divisions, with detachments on the left—Nos. 11 give the word *Left wheel, forward, Right shoulders forward, forward, Right about, Halt, dress.*

With detachments on the right, the words of command are, *Left wheel, forward, Left about, Halt, dress.*

Action ordered to the left—the words of command are the reverse.

In limbering up to the *front, rear,* or *left,* the detachments

ments will be on the left; if to the *right*, on the right. When the commanding officer wishes the detachments to be otherwise posted, he gives the caution before limbering up, as a guide for the led horses to be brought to that post.

14. *A column of sub-divisions, right in front, with detachments on the left of their guns—line formed to the left of the front, for action, to the front.*

Comg. Officer.	*Officers.*	*Nos. 1.*
Left of the front, form line for action to the front,	Ditto,	of 2, the caution, left wheel, of 3, 4, 5, Rt. shoulders, forward, of 1, Dismount,
March,	Ditto,	of 2, Forward, Rt. wheel, forward, Halt, Action to the front, Dismount,
	Left shoulders, forward, Halt, Action to the front, Dismount,	of 4, 5, Left shoulders, forward, Halt, Action to the front, Dismount.

It has been the practice in formation of line for action to the front, to drop the detachments in the rear of their guns; which can only be effected with safety from a previous halt of the whole column, which, although desirable, cannot always be accomplished, particularly when acting with cavalry. Dropping the detachments in the rear has, besides, this disadvantage, that the gun can no longer be

said

said to be under the command of its officer or non-commissioned officer, being then, from the noise of the carriages, removed beyond the extent of his voice.

15, *A column of sub-divisions, left in front, with detachments on the left—line formed to the left of the front, for action to the rear.*

Comg. Officer.	*Officers.*	*Nos. 1.*
Lt. of the front, form line for action to the rear,		of 5, Left wheel,
		of 1, 2, 3, 4, Right shoulders, forward,
	Ditto,	of 6, Dismount,
March,	Ditto,	of 5, Right wheel, forward,
		Halt, Action to the rear, Dismount,
	Left shoulders, forward,	of 2, 4, Left shoulders, forward,
	Forward,	Forward,
	Halt, Action to the rear,	of do. Halt, Action to the rear,
	Dismount,	Dismount.

16. *A*

16. *A coloumn of sub-divisions, right in front—line formed to the right of the rear, for action to the front.*

Comg· Officer.	*Officers.*	*Nos.* 1.
Right of the rear, form line for action to the front,		of 1, 2, 3, 4, 5, Right wheel,
	Ditto,	of 6, Dismount,
March,	Ditto,	of 5, Forward,
	Left shoulders, forward,	of 2, 4, Left shoulders, forward,
	Forward,	Forward,
		of 5, Right wheel, forward,
		Halt, Action to the rear,
		Dismount,
	Left shoulders, forward,	of 2, 4, Left shoulders, forward,
	Forward,	Forward,
	Halt, Action to the rear,	of do. Halt, Action to the rear,
	Dismount,	Dismount.

17. *A line, with detachments on the left—an echellon advancing from the right, in sub-division.*

Comg Officer.	*Officers.*	*Nos. 1.*
Advance from the right in echellon of sub-divisions,	Ditto,	Forward,
	(In succession,)	(In succession,)
March,	March,	of 2, 4, 5, March.

If an echellon is formed for action in advance of the right or left, each sub-division must be halted when the muzzle of the gun is two horses' lengths in front of the leading driver of the sub-division, already halted on its flank. In this situation the guns may be expeditiously brought into action to *front*, *rear*, *right*, or *left*.

18. *A line wheeled into oblique echellon, to the right or left.*

This is performed by a wheel to the flank ordered, of a proportion less than the quarter of a circle. When the movement is to the rear, the sub-divisions are put about in the most convenient manner, and then wheeled forward the necessary part of the quarter circle.

19. *Change*

19. *Change of position on a fixed flank, by throwing the other flank forward or back.*

The pivot sub-division is first wheeled into the new direction, which is then marked by the staff serjeant and markers, who take up the new alignment rapidly. On the word *March*, the whole move on at the pace ordered, except the pivot sub-division, and are *halted* and *dressed* on their respective markers.

20. *The right flank thrown forward, and the left thrown back.*

The commanding officer orders the fourth subdivision to make a half wheel to the left; the new alignment is marked on the left by the staff serjeant; sub-divisions 1, 2, 3, are wheeled to the left; 5 and 6 reverse to the left, and, when sufficiently in the rear, are again reversed to the left, halted, and dressed in the new alignment.

In all movements, the bugle sounds the pace; which is to be considered as a caution. The word *March*, given by the commanding officer, and repeated loudly by the proper officers, is the signal to move.

FAS

Fascines—have different names, according to their size and use.

1. *Saucissons*—are usually made 18 feet long, and from 10 to 12 inches in diameter; and are used for the revetement of embrazures, or for the corners of the parapet.

2. *Battery Fascines*—are made from 8 to 12 feet long, and from 10 to 12 inches thick; used for the revetement of the parapet, &c.

3. *Trench Fascines*—from 4 to 6 feet long, and from 4 to 9 inches thick; used at sieges.

4. *Water Fascines*—6 feet long, from 1 to 2 feet thick; used to cover marshy and wet situations: they must be loaded with stone to make them sink.

5. *Covering Fascines*—are used to form the tops of magazines or saps: they ought, therefore, to be composed of the strongest branches, with the addition of a few poles, that they may bear a considerable weight.

6. *Sap Faggots*—3 feet long, 8 inches thick.

Attention

Attention in making Fascines.—The bands must be from 10 to 12 inches asunder, of birch, hazle, or other pliant wood, well twisted.—The fascines must be drawn close with a choke-rope, previous to being tied.

In laying the wood to form the fascines, the shortest and smallest pieces should be laid inside. Three men are usually employed at each trestle, with two to collect the stuff.

In general a saucisson of 18 feet may be finished at each trestle in half an hour.

Birch and fir are the best woods for this work.

Fascines are sometimes bent so as to coincide with the angles of the battery. The Prussians double some of the fascine stuff, so as to make a loop at the end of the fascine, which, being laid over one another at the corners, and a stake driven through the loops, are very strong.

FIRE-SHIP.—Proportion of combustible Stores for a Fire-Ship of 150 *Tons.*

	N°.
Fire barrels, filled with composition	8
Iron chambers, to blow open the ports	12
Composition for priming, barrels	3½
Quick match ditto	1
Curtains, dipped	48

Proportion

Proportion of combustible Stores for a Fire-Ship of 150 *Tons.* Continued.

	No.
Reeds, long, single dipped	150
Do. short, double dipped	75
Do. short, single dipped	75
Bavins, single dipped	250

The fire-barrels are about 2 feet 4 inches high, and 1 foot 6 inches diameter. Each barrel must have four holes of about 6 inches square cut in its sides; and these holes must have a square piece of canvas nailed over them quite close. They are then filled with the same composition as for carcasses, and 4 plugs, of 1 inch diameter and 3 inches long, and well greased, are thrust into the top, and then left to dry. When dry, these plugs are taken out, and the holes driven with fuze composition, and quick match at the top; which goes from one hole to the other: after this, the top is smeared over with mealed powder mixed up with spirits of wine. When dry again, a sheet or two of brown paper is laid over the top, and then one of the canvas covers, which is made secure by the upper hoop of the barrel.

Composition

Composition for dipping Reeds, Bavins, and Curtains.

	lbs.
Rosin	120
Coarse sulphur	90
Swedish pitch	60
Tallow	6
Mealed powder	12

This proportion will dip about 100 reeds and 25 bavins. Each curtain contains 1 square yard of barras.

Each cover for fire-barrels one of ditto of sacking.

Immediately that the curtains, covers, &c. are dipped, they are to be strewed over with fine brimstone, before the composition grows cold.

The iron chambers, for blowing open the ports, hold from 9 to 11 ounces of powder. They are fixed in such a manner as to prevent their recoil, and to ensure the ports being blown open. The vents are generally corked up, and covered with a piece of barras, till required to be primed.

To fit out a Fire-Ship.—The whole breadth of the fire-room is to be divided into 9 parts, and troughs laid the whole length of the room. Cross troughs of communication are laid between them, about 20 in each row, perpendicular to the long troughs. These troughs are usually 4 inches wide, and 4 deep. There are two fire-trunks and

two

two fire-scuttles on each side, under which the eight fire-barrels are to be placed.

The reeds and bavins are to be tied down in the troughs. —The curtains are to be nailed up to the beams, equally through the fire-room.—The ship is not to be primed when fitted out, but only when intended to be fired.

To Prime.

Composition for Priming.

Saltpetre pulverized	22 lbs.	8 oz.
Rosin	2	11
Sulphur	18	—
Mealed Powder	45	—
Linseed oil	1 pint.	

All the reeds and bavins are to be taken up, and a little of the above composition sprinkled in the bottom of the troughs; the reeds, &c. to be then gently tied down again. —Quick match of 6 or 8 threads doubled, must be laid along on the tops of all the reeds, &c. and the priming composition strewed over it, and over all the fire-room.— The covers of all the fire-barrels must be cut open, and made to hang down on the sides of the barrels.—Leaders of strong quick-match must be laid from the reeds to the barrels and to the chambers; and must be tied down to the vents, to insure its not falling off.—Strong leaders of quick-match, four or five times doubled, must be laid from the reeds to the sally-ports; and the sally-ports must be connected

connected by quick-match, that the whole may take fire at once.

The following method is now adopted of producing an external fire, in addition to the internal fire, before gained by the fire-room.

Fire-boxes, filled with the carcass composition, are distributed in the following manner, in a ship of three masts:

1	Suspended from each of the catheads and davids, on each side the bow	4
8	Slung across the bowsprit	8
4	Across each of the out-riggers abaft	8
2	From the graplins of each of the lower yard arms	12
1	From the dead-eyes on each side of the three round tops	6
1	From the middle of the inside of the main, fore, and mizen shrouds	6
		44

The boxes are suspended by chains and hooks, and those slung across the bowsprit and out-riggers are fixed by staples. The two inner ones are laid with leaders of quick-match, which fire instantly, or with port-fires, which burn a given time; they communicate with the outer ones by reeds, which are tied down on the bowsprit and out-riggers. —The boxes hanging from the dead-eyes and shrouds are fired by curtains suspended from the shrouds, the lower one of which hangs immediately over one of the large fire-barrels.

barrels. The two boxes on each yard-arm are hung one over the other; the upper one having a leader of quick-match carried along the yard from the shrouds; and in burning will no doubt fire the lower one. Besides the boxes, there are fire-barrels arranged as follows:—2 half barrels on the fore-castle; 2 abaft the main-deck, and 4 on the main-deck; 2 in each round-top, placed against the masts; and 4 large fire-barrels under fire-trunks, to convey fire to the curtains on the shrouds. All these fire-barrels and boxes are to be fired by separate leaders of quick-match or port-fire, in order that any part of the ship may be fired, to cover its approach by the smoke; and the remaining part instantaneously upon quitting the ship. It has been found by experiment, that two men with lighted port-fires can set fire to the whole of the leaders on the deck, bowsprit, catheads, out-riggers, &c. in less than a minute; therefore, the risk of trusting to one main leader to the whole, may be avoided.

The leaders are laid in painted canvas hose, made for the purpose.

FLINTS—packed in half barrels.

			Weight.	
			qrs.	lbs.
One half barrel contains.......	Musquet,	2000..	2	14
	Carbine,	3000..	2	10
	Pistol,	4000..	2	15

The

The most transparent and free from veins are esteemed the best flints.

	cwts.	qrs.	
28 kegs of musquet flints take	18	0	in tonnage.
10 kegs — pistol ditto	3	2	ditto.

Musquet Flints—packed in boxes, according to the new system.

Each box contains 1000 flints in five canvas bags. The outside measure of the box is 1 foot 7¾ inches long, 9½ inches in breadth and depth. They are bound at both ends with thin copper plates, about an inch in breadth, and have cleats and rope handles at each end. Two of these boxes are carried in every ball-cartridge waggon.

Weight of empty box................	10½ lbs.
Ditto of 5 bags.....................	1½
Average ditto of 1000 flints	36
Total complete........	48

FORTIFICATION.—Practical Maxims in building Field Works.

1st. The spot on which works are to be constructed should determine their figure; nor should any attention be paid to preserve a regular form which does not occupy the ground to advantage.

2d. Every line must be so disposed, that the slope of hills all around, even to the very bottom, be open to the small

small arms of the garrison; and every part should be discoverable to the distance of at least 500 paces.

3d. Works thrown up for the defence of a defilé should always be within musquet-shot of it, which must not be more than 200 yards.

4th. The best defence in works that are flanked, or when one side is defended by the fire of another, is that formed by right angles.

5th. A salient angle should never be less than 60, and a re-entering angle than 90 degrees; nor greater than 120 degrees.

6th. The entrance to the work should always be made in the part least exposed to attack, and, if possible, in a re-entering angle.

7th. Endeavour to present, if possible, a larger front to the enemy than he can occupy in making the attack.

8th. Avoid all ground commanded by an eminence, either in front, flank, or rear.

9th. Never leave the rear of a work so exposed that the enemy may turn it.

10th. Always make the angles of a work in the directions least exposed to attacks, and consequently always present a front to the most exposed.

11th. The garrison should never be drawn up more than two deep; and an ordinary pace of two feet is usually allowed for each file, and from 6 to 8 paces for each piece of ordnance.

12th. If a work is so large as to be defended by a battalion or two, a reserve should be allowed of about one-sixth of the number.

13th. The space within a work should always be sufficient for the men to move and lie down.—Every soldier will require at least 18 square feet, and every field gun at least 216 square feet.

14th. Provided the line is not made too extensive, the more inward space there is the better.

15th. A parapet to resist cannon-shot should never be less than 12 feet thick; and for musquet-shot not less than 6 feet.

16th. The height of the parapet must be regulated by the situation of the work, and of the adjoining ground; with this consideration, that its height above the banquette does not exceed 4½.

17th. The depth and breadth of the ditch must be regulated by the quantity of earth required for the parapet and banquette.

18th. A tete-de-pont, or work to cover the embarkation of troops, or the passage of a river, should, if possible, be made where the line of the river or coast forms a kind of re-entering angle; that the flanks of the corps, as well as those of the works, may be covered.

To carry on the Works.—The number of workmen must be proportioned to the time allotted for carrying on the work, the quantity of labour, and the number of hands capable

capable of being employed at the same time. When the ditches are broad, the workmen may be posted in two rows, but if narrow, only in one. In the first case, the earth will be thrown by those who are on the outward edge of the ditch to the second row, and by them upon the parapet; for which reason the second row, to keep pace with the first, ought to be twice as numerous. The workmen should never be placed nearer than 2 paces, or 4 feet, from each other; and two men with shovels should be preceded by one with a pick-axe. If more than usual expedition be required, one man with a wheel-barrow, or basket, may be added to six or eight with shovels. Another row of workmen should also be placed upon the parapet, to spread the earth and beat it down, as it is thrown up.

In fixing the fascines, three men will be sufficient for every 24 feet of the work, who should be provided with two mallets, a saw, and a hand-bill, or hatchet.

In order to form some idea of the time in which a field work may be completed, compute the number of cubic feet of earth to be excavated, thus: multiply half the sum of the breadth of the ditch at top and at bottom, by the depth, for the number of square feet in the profile; and this multiplied by the distance between the workmen in feet, will give the number of cubic feet each man has to dig: or being multiplied by the length of the ditch, gives the cubic contents of the ditch. Now, one man is supposed to be able to move 216 cubic feet of earth in a day,

during the summer; but this is not always the case. If a field work be completed in 24 hours, it will be as much as the most diligent workmen are capable of. This time is generally allowed for the formation of a weak profile; 48 hours for that of a stronger, with a revetement of fascines; and 72 for the strongest.

The different slopes for the works must depend upon the nature of the soil, and the materials of which the work is composed.—The interior slope of the parapet, though it be fascined, should be one-sixth of its height; exterior about two-thirds its height.—The slope of the banquette equal to its height.—The slope of the scarpe or counterscarpe of the ditch should be from half its height to its full height, according to the soil.—The superior slope of the parapet must entirely depend upon the situation of the work, and that of the surrounding country.—The interior slope of the parapet is generally lined with fascines, to keep up the earth; but it is not absolutely necessary to fascine the exterior slope, if the soil be pretty stiff. The embrazures are generally made 20 inches wide on the inside, and 9 feet on the outside; they must always be lined with something to retain the earth; turf is generally preferred, as fascines are so apt to take fire.

The manner of making the materials for field works may be seen under the heads *Fascines*, *Gabions*, *Hurdles*, &c.; and the manner of estimating the quantity of materials for works of this kind may be seen under the work *Battery*.

Fortification

Fortification—Permanent.

A *Parapet*, to resist cannon, should never be less than 18 feet thick in earth, and 8 or 9 in masonry. A wall need only be two feet thick in masonry, to resist musquetry.—The parapet should always be $4\frac{1}{2}$ feet above the banquette, and $7\frac{1}{2}$ or 8 feet about the ramparts, or *terre plein.*

The *Rampart* should always be sufficiently wide to allow for the platform, and for two carriages passing each other; about 5 fathoms at top.—A parapet of earth, though it takes more room, is always preferable to one of masonry, when it can be raised; though the only objection to the masonry is the number of splinters it produces.

Entire *Revetements* of masonry are not advantageous for the same reason.—The masonry of revetements should not be so high as to be seen or battered from a distance; earth parapets are battered in vain, as the earth forms a natural slope.

The best *Escarpe* is made of masonry, either in wet or dry ditches, be the earthen one ever so well fraized or pallisaded. The earthen one may be stormed without making a breach.—The escarpe should be 30 or 35 feet high.

The *Counterscarpe* should also be of masonry, and not less than 12 feet high. The inconveniences of an earth or low counterscarpe, are the impossibility of defending to the last the covert-way: as the enemy may descend into the

the ditch, and again mount the covert-way, and so get in the rear of the traverses.—The enemy may find his way along the natural slope of an earth counterscarpe, and is not delayed by a tedious operation of getting into the ditch. Besides, the natural slope of the end of an earth traverse prevents its effectually covering the covert-way.

Ditches are generally 15 or 18 toises wide. Dry ditches are always preferable to wet ones, on account of the shelter they afford the troops, and the ready communication with the outworks, without the constant trouble and danger of bridges.

The *Covert-way* should be 5 toises wide: less would crowd the troops, and more would allow room for the enemy to erect batteries in it.

The whole of the glacis should be seen, not only from the crest of the parapet, but from the embrazures in the parapet.

The *Tenaile* must not be so high as to prevent the flank guns in one bastion seeing the breach that may be made in the collateral one.

Ravelins are best without flanks: their faces directed to 10 toises from the shoulders of the bastions.

The crest of the parapet of the body of the place should be 8 feet above the crest of the glacis, to command it across a ditch of 15 or 20 toises.

The crest of the parapet of the ravelin is 3 feet lower than that of the body of the place, in order that it may be

more effectually commanded from the place; and therefore to enable the parapet of the ravelin to command its own glacis, the ditch is only made 10 toises, and this glacis is a foot lower than that of the body of the place.

There must be an equilibrium of defence established through every front of a fortified place; for it will be needless to strengthen any particular front, if the others from their weakness be left exposed.—The following remarks may enable an observer to appreciate the value of particular works, in the proper application and arrangement of which that equilibrium consists.

Intrenchments within the works add much to their defence. In large bastions with obtuse flanked angles, the best intrenchment is formed of the front of a fortification, or of two demi-bastions and a curtain connecting the angles formed by the flank and curtain. If this intrenchment be advanced to the shoulders of the bastion, so as to include its flanks, as is often the case, it will be subject to be taken in the rear, by the fire from the counter-batteries opposed to the flanks. But in bastions, with acute flanked angles, which do not afford sufficient space for this kind of intrenchment, Cormontaigne proposes one in the form of a cavalier, whose faces and flanks are parallel to those of the bastion. The first kind of intrenchment does not operate in the defence of the place, till after the passage of the ditch; till which time it remains entire, and then capable of a very great defence. The second kind becomes

a support

a support to the bastion from the first commencement of the siege; but it is therefore subject to have its defences destroyed at a distance. Nor is its defence equal to that of the other form.

Counterguards should possess the three following properties: 1st. They must cover effectually the principal work before which they are placed; at least that part of it which can be battered in breach. 2nd. They must be lower than the work which they cover; but not so low as to permit its revetement to be seen. 3d. They must be so narrow as not to afford room for the besiegers to erect batteries in them, against the work which they cover, and therefore not leave the besiegers a choice of positions.—The counterguards in Coehorn's system are only of earth, through which it is necessary to make an opening, before the capital work can be battered.

Horn or *Crown-Works*, unless to occupy some important point, to strengthen some weak side, or to afford more room for a confined garrison, are rather a weak than a strong arm to a place.—This is particularly the case when they are constructed with smaller and consequently weaker fronts than that part of the body of the place which they cover; as they facilitate, when taken, the approaches to the body of the place.—This is remedied by constructing their fronts of the same strength as the front or fronts which they cover. They also facilitate the taking of the place, by exposing the revetement of the work on which

their

their branches are directed to be battered in breach along the ditches of those branches. This is a great evil, even to an outwork, but is of serious consequence if they rest upon the body of the place. This defect has been remedied by placing these works altogether outside of the covert-way, and allowing their ditch no communication with those in the rear. In this case their gorge must be made very secure, to prevent its being turned.

An *Advanced Covert-way* is esteemed amongst the best means of adding to the defence of places. Besides the advantages common to the usual covert-way, it has many peculiar to itself. It however seems necessary to ensure to it the many advantages of which it is susceptible, (besides being properly pallisaded,) that it should be secured in the rear by a wet ditch, as the only means of giving it an inaccessible counterscarpe, and at the same time keeping it under the fire of the musquetry of the place.—This kind of covert-way is generally supported by redoubts upon the capitals of the bastions and ravelins; which, from their position, cannot mask the fire of the place; and being mounted with artillery, oblige the besiegers to commence their attack at a great distance, and very much to extend their operations; and, as their establishment upon this covert-way must effectually mask the fire of their first batteries, it must greatly encrease their labour.—The retreat from these redoubts must be secured by an under-ground passage.

Countermines are undoubtedly one of the first means of strengthening places.—For this article we refer to the word *Mines.*

Detached Redoubts, when circumstance of situation favour them, are employed with great success.—They are usually detached and totally unconnected with any of the works of the place, by any covert-way or other above-ground work: and have for objects, either the opposing an additional obstacle to the besiegers at the point they occupy, or the rendering the adjoining fronts inaccessible, by an enfilade or reverse fire upon the approaches.—They also afford at their gorge, a most excellent rendezvous and retreat for sorties, upon the level of the country, and without the difficulty of filing troops through the barrier of a covert-way.

But, in order to ensure to the detached work or works all these advantages, it is necessary that they should be either totally inaccessible to the besiegers, by reason of the natural difficulties of their situation, as in an inundation, morass, &c. or be made secure by art, from being taken by storm, and only attackable by regular approaches. They should be under cover of the fire of the place; but if their distance be too great for that, an intermediate work must be established to give them support. Their best form is that of a bastion with retired flanks; and a strong system of countermines the most effectual way of prolonging their assistance.

General

General Remarks.—The larger the flanked angles of works, the more direct will be the fire, and that of their covert-way, upon the approaches; the greater extent will they oblige the besiegers to occupy in their parallels and batteries; and the more will they oblige the besiegers to expose themselves to the fire of the fronts collateral to the one attacked.—Faces of works directed to inaccessible situations, such as rivers, lakes, &c. from whence they cannot be enfiladed by ricochet batteries, add greatly to the strength of a front.

If the flanked angle of a ravelin be so advanced as to see in reverse any battery erected upon the crest of the glacis, or in the covert-way of the bastions, it will encrease the strength of that front; because it will oblige the besiegers to gain possession of the ravelin, before they can make any lodgment, from which they can batter the bastions.—This is the case in Cormontaigne's system: and a place thus fortified, obliges the besiegers to attack and gain two ravelins, to get at the bastion between them.—Besides, if this system be applied to a right line, or to a polygon of many sides, the prolongations of the faces of the bastions will be intercepted by the flanked angle of the ravelins, and consequently make the establishment of enfilading batteries against them very difficult.—A work which admits of a breach being made in it (particularly the body of the place) at a distance, very much facilitates its being taken.—The ditch of the ravelin affords an opening through which the besiegers

besiegers may make a breach in the face of the bastion, from the glacis, opposite the flanked angle of the ravelin, and is therefore subject to this defect.—A counterguard before the bastion lessens this evil, by transferring the breach from the body of the place to the ravelin; but it requires a counterguard also before the ravelin effectually to cure it.—A crown or horn-work also produces this evil; its remedy was given in speaking of those works.

The direction of the flanks or faces of a work is not so material as relating to the fire of artillery, as to that of musquetry; for artillery is never fired without being pointed, but musquetry is fired mechanically, and perpendicular to the parapet, without much attention to the object to be struck.

A work in the neighbourhood of a height must be defiladed* from that height, that is, instead of being built upon a horizontal plane, it must be erected upon an imaginary inclined plane, passing from somewhere in the interior of that work over the most commanding points of the height:

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* The compiler must here apologize for coining the word *defiladed*, which he is obliged to do, never having seen this subject treated of in English. But the French use the word *defile* in a contrary sense to *enfile:* and as we admit the words enfilade and enfiladed from the latter, we cannot refuse the terms defilade and defiladed from the former.

and every part of the works must bear the same relation to this inclined plane, that they would do to a horizontal plane in a level country.

A work is not therefore always to be condemned, because it is in the neighbourhood of a height; for if it be properly defiladed from that height, it will receive a great advantage over the approaches of the besiegers, carried on down an inclined plane towards it. But a work, to be properly constructed in the neighbourhood of heights, must not uniformly preserve the same distance from those heights, unless their summits be all upon the same level; but must approach them at their lowest parts, and recede from them as they rise; thus will the necessary plane of defilement preserve nearly the same degree of obliquity throughout.

The Dimensions in the following Table of VAUBAN *are thus applied:*

The *Fort* is mostly for squares.

The *Little* for citadels, commonly pentagons.

The *Mean* for all fortifications from the hexagon and upwards.

The *Great* is seldom used but in irregular fortifications, and particularly on rivers.

Principal Dimensions of Fortifications, according to VAUBAN.

	Forts.						Little Fortification.				Mean.		Great.	
Side of Polygon......	80	90	100	100	120	130	140	150	160	170	180	190	200	260
Length of perpendicular .	10	12	12½	14	15	16	20	21	23	25	30	31	25	22
Faces of Bastions......	22	25	28	30	33	35	40	42	45	47	50	53	55	60
Capital of Ravelins.....	25	28	30	35	38	40	45	50	50	52	55	55	60	50

Dimensions of Walls and their Counterforts from 10 *to* 50 *feet high, having a slope of one-fifth their height.*

Wall.			Counterforts.		
Height	Thickness at Top.	Thickness at Bottom.	Distance between them.	Breadth.	Length.
Feet.	Ft. In.	Ft. In.	Feet.	Ft. In.	Ft. In.
10	4 0	6 0	8	2 8	4 —
15	4 3	7 3	10	3 4	5 —
20	4 6	8 6	12	4 0	6 —
25	4 9	9 9	14	4 8	7 —
30	5 0	11 0	16	5 4	8 —
35	5 3	12 3	18	6 0	9 —
40	5 0	13 6	20	6 8	10 —
45	5 9	14 9	22	7 4	11 —
50	6 0	16 0	24	8 0	12 —

The heights in the above table are taken only from the bottom of the ditch, and do not include the foundations.

When the rampart is partly walled and partly turfed, then one-fifth of the height of the turfed part must be added to the breadth of the wall at the top given in the table.

The bases of all inward slopes of earth should be equal to their height, if not more.

The bases of all outward slopes of earth, two-thirds of their height.

The

The superior slopes of all parapets, one-sixth of their breadth.

The slope of all walls or revetements, one-fifth of their height.

Though the above principles given for the erection of field works, may assist an officer's recollection who may be employed on that duty, the memorandums given respecting *permanent* fortification pretend to no such object; but may serve to remind an officer, if he should visit a fortification, of its essential requisites; and may assist his observations in passing round the works.

FUZES—Composition.

Saltpetre................	3 lbs.	4 oz.
Sulphur	1	—
Mealed powder	2	12

This proportion to be well mixed with the hands, then run four times through a fine hair sieve, and mixed a second time. For short distances, mealed powder only may be used; it burns twice as fast, consequently the fuze will be longer, and easier fixed into the shell.

Dimensions

Dimensions of common Fuzes, before they are driven with Composition.

Nature.	Exterior.		Diameter of the Bore.	Length of the Bore, including the Cup.	Length of the solid Bottom.	Depth of the Cup	Diam^r of the Cup at the mouth.
	Greatest Diameter.	Diameter at the bottom of the Bore					
	Inches	Inches	Inches	Inches	Inch.	In.	In.
13-inch	2·494	1·57	0·525	9·1875	1·05	·75	1·4
10	2·137	1·35	0·45	7·875	0·9	·7	1·2
8	1·781	1·125	0·375	6·9375	0·75	·55	1·
$5\frac{1}{2}$	1·306	0·825	0·275	4·8125	0·55	·4	·7
$4\frac{2}{5}$	1·187	0·75	0·25	3·875	0·5	·4	·6
H^{d}Gren^{ades}	·9	0·6	0·2	2·55	0·4	·3	·5

Dimensions of Fuzes for Spherical Case Shot.

Nature	Diameter at top.	Diam^r at bottom.	Length of Fuze.	Depth of the Cup	Diam^r of the Cup	Remarks.
	In.	In.	In.	In.	In.	4 holes are made at the top for the quick-match ends. These fuzes taper from end to end, without exterior bulge in the cup: the diam^r of the bore is the same as common fuzes.
8-inch	1·31	1·7	2·	·2	$\frac{7}{8}$	
$5\frac{1}{2}$	0·95	0·75	2·	·2	$\frac{5}{8}$	

An inch of fuze, if well driven, should burn 5 seconds.

The

The articles necessary for driving fuzes are, large elm blocks, with holes at top, to receive the brass sockets in which the fuzes are to be fixed, proper mallets, iron drifts tipt with brass, copper ladles of each nature, square boxes for holding the composition, quick-match and mealed powder.

In driving fuzes, the principal points to be attended to, are, to put in equal quantities of composition each time, which is effected by passing a round stick over the edges of the ladle, to take off the composition along the edges, and to keep the strokes as steady and regular as possible, giving always the same number to each ladle-full. The fuzes must always be driven to the same height, for which purpose the last drift is marked. They are afterwards primed with quick-match, and a ladle-full of mealed powder put over it, which must be driven down with fifteen strokes of the mallet, and the cup filled up with mealed powder moistened with spirits of wine, well pressed in with the finger. In two or three days, when the mealed powder is dry, they are completed by a circle of paper on the top of the cup, and a cap of brown paper or painted canvas tied on over all.

Fuzes may be driven with blind fire composition, which will not discover the flight of the shell in the night.

		lbs.	oz.
For 13 and 10-inch Fuzes,	Mealed powder,	6	0
	Wood ashes . . .	4	0
For 8 and smaller Fuzes,	Mealed powder,	7	0
	Wood ashes . . .	0	3

The fuze to be driven as usual with the above composition, with one ladle-full of the proper fuze composition driven at the top with the quick-match, for priming.

To find the Length of Fuzes for any Range.

The 13 and 10-inch fuzes of the same length burn so nearly equal, that one common length answers both, as do the 8-inch, $5\frac{1}{2}$, $4\frac{2}{5}$.—Therefore, to find the length of fuze for any range, multiply the time of flight by ·22 for the 13 and 10-inch, and ·24 for the 8, $5\frac{1}{2}$, and $4\frac{2}{5}$; which is the decimal part of an inch a fuze burns in a second. Fuzes are thought to keep better by being painted; and for field service, are often marked off by black lines into seconds and half seconds.

Table for driving Fuses, Weight and Length of Quick-Match, Weight of Composition, &c.

Nature of Fuze.	Weight of Composition.	Nature of Ladles.	N° of Blows to each Ladle-full.	Weight of Quick-match.	Length of Quick-match.	N°. of Threads of Quick-match for each.	N°. each Man drives per Diem.	Time each will burn.
	oz. dr.	oz. dr.	N°.	oz. dr.	In.	N°.	N°.	Sec^nds^.
13-Inch.	2 8	2 0	21	0 8	17	4	9	35 to 38
10-Ditto	1 8	1 0	18	0 6	14	4 or 3	9	33 to 35
8-Ditto	1 0	0 8	15	0 4	12	3	12	29 to 31
5½-Ditto	.. 6	0 6	13	0 3	10	2	16	18 to 21
4⅖-Ditto	.. 6	0 4	12	0 3	8	2	16	15 to 17
Hand-gr.	.. 3	....	10	....	....	......	28	
Musqtoons	.. 2	....	9	....	....	......	28	

Composition of French Fuzes.

	Mealed Powder.	Saltpetre.	Sulphur.
	Pts.	Pts.	Pts.
For 12-Inch Shells—common........	5	3	2
Do.——————quick	7	4	2
Do.——————quicker	10	6	3
Do.——————quickest	5	3	1
For 8-Inch, 6-Inch, and Grenades....	4	3	2
Do.——————quick	5	3	2
Do.——————quicker	10	6	3

GABIONS.

GAB.

GABIONS.—Small gabions of 3 feet high, and 2 feet diameter, are made with least trouble, and are easiest carried. The pickets for them must be 1½ or 2 inches thick, and 4 feet long. Large gabions are 6 feet high, and 3 feet in diameter; and require two men to carry them. The smallest gabions, or baskets, are formed of pickets, 1 inch in thickness, and 1 foot long: they are 12 inches in diameter at top, and 10 at bottom. The small gabions have 7 or 8 pickets, the large ones 9 or 10.

To make them.—The pickets are first to be fixed in the ground in a circle, the size of the bottom of the intended gabion; then a few twigs are to be wove through the upper ends, to keep them from flying out; afterwards the work must be begun at the bottom, and continued upwards; and the whole being well driven down with a mallet, the edges must be secured by twigs, watled up and down. The twigs of willow, birch, hazle, alder, poplar, and beech, are proper for this purpose. The top of the gabion must be made very even, because that becomes the bottom when finished. Four men are usually employed on each gabion, with a bill-hook, a mallet, a spade, and two axes. Two collect the

the wood, while the other two form the gabion. A 3-foot gabion ought to be made in half an hour.

GIN—Large Triangle, new Pattern.—Length of arms, 18 feet 6 inches; roller, 7 feet 4 inches; racket wheel, diameter, 1 foot two inches; length of the pall, 1 foot; weight, 8cwt. 2qrs. 16lbs. This gin is intended for mounting guns on traversing platforms.

GIN—Small Triangle.—Length of arms, 16 feet 4½ inches; roller, 6 feet. This gin is intended for mounting guns on garrison and travelling carriages.

White rope for a gin,	Sling, 6¾ inch..	4 fathoms,
	Fall, 5 inch..	14 fathoms 2 inches.

GRAVITY.—Table of the Specific Gravity of several Solid and Fluid Bodies.

Platina	23400	Clay	2160
Fine gold	19640	Brick	2000
Standard gold	18888	Common earth	1984
Lead	11352	Nitre	1900
Quicksilver	11325	Ivory	1825
Fine silver	11091	Brimstone	1810
Standard silver	10535	Solid gunpowder	1745
Copper	9000	Sand	1520
Copper halfpence	8915	Coal	1250
Gun metal	8784	Box-wood	1030
Cast brass	8000	Sea water	1030
Steel	7850	Common water	1000
Iron	7645	Oak	925
Cast Iron	7425	Gunpowder, close stacken	937
Tin	7320	Ditto in loose heap	836
Crystal Glass	3150	Beech	852
Marble	2700	Ash	800
Slate	2671	Maple	755
Granite	2654	Elm	600
Common green glass	2600	Fir	550
Flint	2570	Charcoal	
Common stone	2520	Cork	240
Chalk	2370	Air	1·232

The

The several sorts of wood are supposed dry.

This table also contains the weight of a cubic foot of each body in avoirdupois ounces: from whence results the following rules:

1. *To find the Magnitude of any Body from its Weight.*

As the tabular specific gravity of the body
Is to its weight in avoirdupois ounces,
So is one cubic foot, or 1728 cubic inches
To its content in feet or inches respectively.

2. *To find the Weight of a Body from its Magnitude.*

As one cubic foot, or 1728 cubic inches
Is to the content of the body,
So is the tabular specific gravity
To the weight of the body.

GRAPE-SHOT.—See the word *Shot.*

GRAZE FIRST.—General Rules for finding the first graze of field guns:

12-pounder, 9-pounder, and heavy 6-pounder.—charge $\frac{1}{3}$ of the shot's weight, point blank 300 yards, each $\frac{1}{4}$ of a degree up to 1 degree increases 100 yards, each $\frac{1}{4}$ to 2 degrees increases 75 yards, and each $\frac{1}{4}$ to 3 degrees 50 yards.

The

The light 6-pounder—charge 1lb. 8oz. first graze point blank 200 yards, each $\frac{1}{4}$ of a degree up to 1 degree, or the line of metal, increases 100 yards, and each $\frac{1}{4}$ to 3 degrees increases 50 yards.

Light $5\frac{1}{2}$ *howitzer*—charge 1lb. first graze point blank 150 yards, each degree as far as 4 degrees increases 150 yards, each degree as far as 8 degrees increases 100 yards, and for each degree as far as 12 degrees increases 50 yards; 1 inch of fuze bursts the shell at 700 yards, 2 inches at 1200 yards, and 3 inches at the end of the range.

Twenty-four pounder brass gun, P. B. 480 yards, each $\frac{1}{4}$ as far as 2 degrees increases 64 yards; to 3 degrees 91; from 3 to 4, 55; from 4 to 5, 47 yards.—1*st. graze*, with iron ordnance, from a 32-pounder to a 12-pr. inclusive.—Each $\frac{1}{4}$ of a degree increases 100 yards, up to 2 degrees; from 2 to 5 degrees, 50 yards; from 5 to 6 degrees, 45 yards; from 6 to 7 degrees, 42 yards.

Note.—For the new 12-pounder and 24-pounder brass howitzers, see *Tables of Ranges*, under the head of *Howitzers.*

First Grazes with a Brass 24-Pounder Gun.

Charge 6 lbs.		Charge 10 lbs.	Charge 6 lbs.		Charge 10 lbs.
Elevation.	Range.	Range.	Elevation.	Range.	Range.
Degrees.	Yards.	Yards.	Degrees.	Yards.	Yards.
P.B.	480	480	2¾	1265	1274
¼	544	571	3	1320	1332
½	608	662	3¼	1378	1387
¾	672	753	3½	1436	1442
1	736	844	3¾	1496	1497
1¼	827	908	4	1552	1552
1½	918	972	4¼	1599	1599
1¾	1009	1036	4½	1646	1646
2	1100	1100	4¾	1690	1693
2¼	1155	1158	5	1746	1740
2½	1210	1216			

Table of First Grazes with Iron Ordnance, from a 32-Pounder to 12-Pounder, inclusive.

Elevation.	Range.	Elevation.	Range.
P. B.	400	1¾	1100
¼	500	2	1200
½	600	2¼	1250
¾	700	2½	1300
1	800	2¾	1350
1¼	900	3	1400
1½	1000		

Table of First Grazes with Field Guns.

Elevation.	First Graze.		Old Pattern. Howitzers.		New Pattern. 24-Pr. Howitzer. Charge $2\frac{1}{2}$lbs.			New Pattern. 12-Pr. Howitzer. Charge $1\frac{1}{4}$lbs.		
	12-Pr. 9-Pr. and Long 6-Pr.	Light 6-Pr.	Elev^tion	First Graze.	Elevat^n	Fuze.	Range.	Elevat^n	Fuze	Range.
P.B.	300	200	P.B.	150	$1\frac{1}{2}$	·2	500	$1\frac{1}{2}$	·2	500
$\frac{1}{4}$......	400	300	1	300	2	·3	600	2	·3	600
$\frac{1}{2}$......	500	400	2	450	$2\frac{1}{4}$	·4	700	$2\frac{1}{2}$	·4	700
$\frac{3}{4}$......	600	500	3	600	$2\frac{1}{2}$	·5	800	3	·5	800
1 degree.	700	600	4	750	3	·6	900	$3\frac{1}{2}$	·6	900
$1\frac{1}{4}$......	775	650	5	850	$3\frac{1}{2}$	·7	1000	$4\frac{1}{4}$	·7	1000
$1\frac{1}{2}$......	850	700	6	950	$4\frac{1}{2}$	·9	1100	$5\frac{1}{4}$	·9	1100
$1\frac{3}{4}$......	925	750	7	1050						
2 degrees	1000	800	8	1150						
$2\frac{1}{4}$......	1050	850	9	1200						
$2\frac{1}{2}$......	1100	900	10	1250						
$2\frac{3}{4}$......	1150	950	11	1300						
3 degrees	1200	1000	12	1350						

GREASE.—The composition used for greasing wheels in the artillery service is composed of equal parts of tallow and the coarser kind of sweet oil melted together, and made up in kegs of 28lbs. each. In warm climates it will require a greater proportion of the former ingredient.

GRENADES.—Hand-grenades may be thrown to the distance of 13 fathoms.—For their dimensions, see the word *Shell.*

GUAGES.

New Table of Guages. 1825.

Round Shot.			Shells, Common and Spherical by Pounders.		Shells for Mortars and Howitzers by Inches.		
Pr.	High.	Low.	High.	Low.	In.	High.	Low.
68	7·95	7·85	Same as shot.	Same as shot.	13	12·88	12·8
42	6·795	6·729	Do.	Do.	10	9·88	9·8
32	6·207	6·147	Do.	Do.	8	7·95	7·85
24	5·639	5·584	5·62	5·57	$5\frac{1}{2}$	5·62	5·57
18	5·124	5·074	Same as shot.	Same as shot.	$4\frac{2}{5}$	4·476	4·432
12	4·476	4·432	Do.	Do.			
9	4·1	4·06	Do.	Do.			
6	3·568	3·532	Do.	Do.			
4	3·124	3·053					
3	2·833	2·803					
2	2·484	2·423					
$1\frac{1}{2}$	2·269	2·201					
1	1·969	1·923					
$\frac{1}{2}$	1·549	1·519					

GUNNERY.—By the assistance of good tables of practice, and the tables of amplitudes, sines, tangents, and secants, all the cases in gunnery, in a non-resisting medium, may be easily solved: and perhaps the solution may be sufficiently correct for practice, if the initial velocity of the projectile be not so great as to make the air's resistance considerable.

For the tables of ranges with ordnance, see the different natures, as *Gun*, *Mortar*, &c.; and for the tables of amplitudes, sines, tangents, and secants, see page 189, &c.

Upon Horizontal Planes.

1. The greatest range is at 45° nearly.
2. The ranges with different elevations with the same charge, are as the double sines of the angles of elevation.
3. Any angle and its complement give the same range nearly.
4. The times of flight are as the sines of the angles of elevation.
5. The altitude of the curve, at any elevation, is found by this proportion: as Radius: tangent of angle of elevation : : $\frac{\text{range}}{4}$: altitude.
6. The time of flight at 45° is equal the square root the range in feet, divided by 4, or more nearly $= \sqrt{\text{quotient}^2}$ of the range in feet, divided by 1·61, or the space passed through in the first second by gravity.

Having

Having the first graze with a given elevation and charge, to determine the charge for any other first graze and elevation, multiply the known charge and elevation into the proposed first graze; also the proposed elevation into the known first graze, and divide the first product by the last, for the charge required.

Upon inclined Planes, at 45° Elevation.

Case 1*st. Given the charge and inclination of the plane to find the range:*

Multiply the horizontal range with this given charge (found in the tables of ranges,) by the number found opposite the angle of inclination of the plane, in the first column of multipliers, in the table of amplitudes, under the head *Ascents*, if it be inclined above the horizon; and *Descents*, if below the horizon, for the range required.

Case 2d. *Given the range and inclination of the plane, to find the charge:*

Multiply the number found in the above-mentioned table opposite the angle of inclination of the plane, in the second column of multipliers, under the head *Ascents* or *Descents*, according as it is above or below the horizon, by the given range; for the range on a horizontal plane at 45°, the charge for which may be found from the tables of ranges.

Upon

Upon inclined Planes, at any Elevation.

There are always two elevations with which any range, (less than the greatest,) may be made, and these elevations are always the complements of each other.—The greatest range upon a horizontal plane is at 45°; or when the direction bisects the angle formed by the horizontal and vertical plane; also the greatest range upon any plane is made with that direction which bisects the angle between the plane and the zenith; and all other directions which make equal angles with this direction, (on each side of it,) will also make equal ranges on the said plane; for the direction that bisects the angle between any plane and the zenith is the same with respect to that plane as the direction at 45° is with respect to the plane of the horizon.

Rules.—1st. The elevation which gives the greatest range on a given ascent, is equal to half the sum of 90° added to the ascent.

2d. The elevation which gives equal ranges on a given ascent are the complements of each other added to the ascent.

3d. The elevation which gives the greatest range on a descent, is equal to half the complement of the descent.

If the range and inclination be given, the least charge that will reach the object, may be found as follows:—multiply the tangent of the proper elavation into the proposed range, for the horizontal range whose charge is required.

WILLIAMS'S GUNNERY.

Table

Table of Amplitudes.

Degrees.	Ascents. Multipliers.		Descents. Multipliers.		Degrees.	Ascents. Multipliers.		Descents. Multipliers	
	1st cl.	2d cl.	1st cl.	2d cl.		1st cl.	2d col.	1st cl.	2d cl.
1	·983	1·02	1·02	·983	24	·607	1·64	1·58	·633
2	·966	1·03	1·04	·966	25	·589	1·70	1·62	·617
3	·949	1·06	1·05	·950	26	·570	1·76	1·66	·603
4	·932	1·07	1·07	·932	27	·550	1·82	1·69	·592
5	·916	1·09	1·09	·916	28	·530	1·86	1·73	·578
6	·900	1·11	1·11	·900	29	·510	1·96	1·78	·562
7	·884	1·13	1·13	·884	30	·488	2·05	1·82	·549
8	·868	1·15	1·15	·868	31	·466	2·14	1·87	·534
9	·852	1·18	1·17	·853	32	·442	2·26	1·92	·526
10	·836	1·20	1·19	·836	33	·418	2·41	1·97	·508
11	·821	1·22	1·22	·821	34	·393	2·55	2·02	·495
12	·805	1·24	1·24	·805	35	·366	2·73	2·08	·488
13	·789	1·27	1·27	·789	36	·338	2·96	2·13	·470
14	·774	1·29	1·29	·774	37	·309	3·24	2·20	·455
15	·758	1·32	1·31	·763	38	·278	3·60	2·26	·443
16	·742	1·35	1·34	·745	39	·245	4·09	2·33	·430
17	·726	1·38	1·37	·730	40	·210	4·80	2·40	·417
18	·711	1·40	1·39	·720	41	·173	5·78	2·48	·404
19	·693	1·45	1·42	·704	42	·134	7·46	2·56	·390
20	·677	1·48	1·45	·690	43	·092	10·90	2·64	·380
21	·660	1·52	1·48	·675	44	·045	22·22	2·73	·370
22	·643	1·56	1·52	·662	45	·000	infinite	2·83	·360
23	·625	1·60	1·55	·645					

Table of Natural Sines, Tangents, and Secants.

Degrees.	Sines.	Tangents	Secants.	Degrees.	Sines.	Tangents	Secants.
1	·018	·018	1·000	34	·559	·675	1·206
2	·035	·035	1·000	35	·574	·700	1·221
3	·052	·052	1·001	36	·588	·727	1·236
4	·070	·070	1·002	37	·602	·754	1·252
5	·087	·087	1·004	38	·616	·781	1·269
6	·105	·105	1·006	39	·629	·810	1·287
7	·122	·123	1·008	40	·643	·839	1·305
8	·139	·148	1·010	41	·656	·869	1·325
9	·156	·158	1·012	42	·669	·900	1·346
10	·174	·176	1·015	43	·682	·933	1·367
11	·191	·194	1·019	44	·695	·966	1·390
12	·208	·213	1·022	45	·707	1·000	1·414
13	·225	·231	1·026	46	·719	1·036	1·440
14	·242	·249	1·031	47	·731	1·072	1·466
15	·259	·268	1·035	48	·743	1·111	1·494
16	·276	·287	1·040	49	·755	1·150	1·524
17	·292	·306	1·046	50	·766	1·192	1·556
18	·309	·325	1·051	51	·777	1·235	1·589
19	·326	·344	1·058	52	·788	1·280	1·624
20	·342	·364	1·064	53	·799	1·327	1·662
21	·358	·384	1·071	54	·809	1·376	1·701
22	·375	·404	1·079	55	·819	1·428	1·743
23	·391	·424	1·086	56	·829	1·483	1·788
24	·407	·445	1·095	57	·839	1·540	1·839
25	·423	·466	1·103	58	·848	1·600	1·887
26	·438	·488	1·112	59	·857	1·664	1·942
27	·454	·510	1·122	60	·866	1·732	2·000
28	·469	·532	1·133	61	·875	1·804	2·063
29	·485	·554	1·143	62	·883	1·881	2·130
30	·500	·577	1·155	63	·891	1·963	2·203
31	·515	·601	1·167	64	·898	2·050	2·281
32	·530	·625	1·176	65	·906	2·145	2·366
33	·545	·649	1·192	66	·914	2·246	2·459

Table of Natural Sines, Tangents, and Secants,
Continued.

Degrees.	Sines.	Tangents	Secants.	Degrees.	Sines.	Tangents	Secants.
67	·921	2·356	2·559	79	·982	5·145	5·241
68	·927	2·475	2·669	80	·985	5·671	5·759
69	·934	2·605	2·790	81	·988	6·314	6·392
70	·940	2·747	2·924	82	·990	7·115	7·185
71	·946	2·904	3·072	83	·993	9·144	8·206
72	·951	3·078	3·236	84	·995	9·514	9·567
73	·956	3·271	3·420	85	·996	11·430	11·474
74	·961	3·487	3·628	86	·998	14·301	14·336
75	·966	3·732	3·864	87	·999	19·081	19·107
76	·970	4·011	4·134	88	·999	28·636	28·654
77	·974	4·331	4·445	89	·999	57·290	57·299
78	·978	4·705	4·810	90	1·000	infinite	——

GUNS—Calibres of English and Foreign Guns, expressed in English Inches.

English.		French.		Spanish		Dutch.		Russian.		Portug.	
Pr	Inches	Pr	Inches	Pr	In.	Pr	In.	Pr	Inches	Pr	Inches
42	7·018	..	....	..	....	..	....	36	6·86	48	7·49
32	6·41	36	6·9	36	6·84	32	6·4	30	6·47	36	6·8
24	5·823	24	6·03	24	6·03	24	5·92	24	6·	24	5·93
18	5·292	16	5·26	18	5·52	18	5·45	18	5·45	18	5·4
12	4·623	12	4·78	12	4·8	12	4·76	12	4·76	12	4·7
9	4·200	8	4·18	9	4·2	8	4.73	8	4·17	9	4·3
6	3·668	..	....	..	....	6	3·78	6	3·78	6	3·75
4	3·204	4	3·315								
3	3·013										
1	2·019										

Guns.—Weight and Length of English Brass Guns.

Nature.		Length in Calibres	Ft.	In.	Weight. ct.	qrs.	lbs.
42-Pounders		16·244	9	6	66	—	—
32———		18·721	10	0	55	2	—
24	Heavy	19·574	9	6	53	0	9
	Medium	16·483	8	0	41	3	2
	Light	10·302	5	0	16	3	13
	Ditto new	13·000	6	3	24	0	—
18 Light Ditto		13·000	5	9	18	0	—
12	Heavy	24·659	9	0	31	2	8
	General Desagulier's	19·468	7	6	22	1	21
	Medium, old	16·872	6	6	21	3	—
	Medium, new	16·872	6	6	18	—	—
	Light	12·978	5	0	8	3	4
	Ditto, new	13·000	5	0	12	—	—
9 Pounder		......	6	0	13	2	—
6	Heavy	26·112	8	0	19	1	6
	Gen. Desagulier's Med.	2·876	7	0	12	0	24
	Medium, new	18·500	6	0	8	3	27
	Medium, reduced	17·000	5	6	8	0	22
	General Belford's	16·342	5	0	5	2	21
	Light, common	14·706	4	6	5	—	18
3	Heavy	28·836	7	0	11	3	19
	General Desagulier's	14·717	6	0	6	—	—
	Light, common	14·418	3	6	2	2	27
	Light Infantry	12·358	3	0	1	3	16
	General Pattison's	12·358	3	0	1	2	19
1-Pr. Ammuzette		29·7	5	0	2	2	12
Ditto		15·6	6	0	3	0	11
Ditto		11·5	7	0	3	1	12

MAHARAJA SERFOJI'S

Table

Table of Brass Field Guns in Current Service, 1827.

Nature.	Length		Weight.			Nature.	Length		Weight.		
	ft.	in.	cwt.	qr.	lb.		ft.	in.	cwt.	qr.	lb
12-pr.	6	6	18	0	0	3-prs.	6	0	6	0	0
	5	0	12	0	0		4	0	3	0	0
9-pr...	6	0	13	2	0		3	0	2	1	0
6-pr.	7	0	12	0	0	1-pr. ..	5	0	2	2	0
	5	0	6	0	0						

Length and Weight of French Brass Guns, in their own Weight and Measure.

Nature.			Length in				Weight.
			Calibers.	Ft.	In.	Li.	lbs.
24-Pounder	Siege	—	—	9	11	5	5628
16 ———		—	—	9	7	—	4111
12 ———	Garrison	—	—	—	—	—	3184
8 ———		—	—	—	—	—	2175
12 ———	Field	—	18·	6	6	—	1808
8 ———		—	18·	5	8	—	1196
1 ———		—	18·	4	6	—	590
1 ———	—	—	—	—	—	—	266

Weight

Weight and Length of English Iron Guns.

Nature.	Length in			Weight.			* Proportion between shot and gun.
	Calibers.	Ft.	In.	Ct.	Qr.	lbs.	
68-Prs.		6	8	50	0	0	
42 —	17·098	10	—	67	—	—	
	16·244	9	6	65	—	—	170
42 —	18·721	10	—	58	—	—	
	17·725	9	6	55	—	—	193
24 —	20·604	10	—	52	—	—	
	19·574	9	6	49	2	—	231
	18·542	9	—	47	2	—	
18 —	21·542	9	6	42	—	—	
	20·408	9	—	40	—	—	249
12 —	24·659	9	6	34	—	—	
	23·361	9	—	32	—	—	
	22·063	8	6	31	2	—	
	19·468	7	6	29	1	—	294
9 —	21·4	7	6	24	2	—	305
	19·9	7	—	23	—	—	
6 —	26·2	8	—	22	—	—	
	19·6	6	—	16	2	—	411
4 —	22·4	6	—	22	1	—	343
	20·6	5	6	11	1	—	
3 —	18·6	4	6	7	1	—	270

* This column expresses the number of pounds of metal in the guns to each pound in the shot.

Table

Table of Iron Guns used for arming the Navy, 1826.

Nature.	Diameter of the Bore.	Length.		Weight.		
	inches diam.	feet.	inches.	cwt.	qr.	lb.
68-Pr.	Gen. Millar's	6	8	50	0	0
32 ..	6·41 {	9	6	55	2	0
		8	0	47	2	0
24 {	5·583	9	6	50	0	0
	.....	9	0	47	2	0
	Congreve's.	7	6	40	0	0
18 {	5·292	9	0	42	0	0
	.....	8	0	37	2	0
12 {	4·623	9	0	34	0	0
	.....	7	6	29	2	0
9 ..	4·2	7	6	26	0	0
6 ..	3·668	6	0	17	0	0

Table of Iron Guns, in current Land Service, 1827.

Nature:	Length.		Weight.		
	feet.	inch.	cwt.	qr.	lb.
24-Pr.	9	0	48	0	0
18-Pr.	9	0	40	0	0
12-Pr. {	6	0	24	0	0
	6	0	21	0	0
9-Pr.	5	6	17	0	0
6-Pr. {	4	10	11	0	0
	3	6	6	2	0

French Iron Guns, in English Weights, &c.

Nature.	Length in Calibers.	Length in Ft.	Length in In.	Weight. Cwt.	Weight. Qrs.	Weight. lbs.
36-Pounders	16·18	9	8	74	3	—
24	18·18	9	1½	51	—	—
16	21·01	9	7	42	—	—
16	18·45	8	4	43	2	—
16	16·92	7	8½	35	—	—
12	21·54	8	7	31	2	—
12	20·5	8	2	20	3	—
12	17·14	6	10	28	—	—
8	24·64	8	7	24	1	—
8	17·22	6	—	16	—	—
4	17·19	4	9	—	—	—

Ranges of Brass Guns, with one Shot.

Nature.	Charge	To the first graze of the Shot. P. B.	1°	2°	3°	4°	5°
		yds.	yds.	yds.	yds.	yds.	yds.
24 Heavy	8 0	473	781	1032	1405	1585	1710
24 Medium	8 0	488	757	1103	1425	1557	1745
24 Light	3 0	162	364	606	722		1390
12 Heavy							
12 Medium	4 0		705	973	1189		
12 Light	3 0		601	816	1063		
Desagulier's	2 0		646	966	1325		
6 6-Feet	2 0		683	948	1327		
6 5 : 6 Medium	2 0		775	1003	1444		
6 5 : 6 Red.	2 0		642	976	1150		
6 5-Feet	1 8		587	825	950		
6 4 : 6	1 8		628	804	991		
3 Desagulier's	1 0		679	883	918		
Ammuzette of 5 feet	0 8		604	800			
Do. 7 feet	0 8		656	839	1000		

Ranges from Brass Guns, with Two Shot, 1793.

Nature.	Charge. lbs.	Charge. oz.	Elevation. Deg.	Elevation. Min.	Medium of first graze. 1st Shot.	Medium of first graze. 2d Shot.
12-Pounder, Medium........	4	—	1	30	607	706
6 : Desagulier's	2	—	1	30	621	739
6 : of 5 feet	1	8	1	30	586	732
3 : Desagulier's...........	1	—	1	30	523	638

Ranges from Brass Field Guns, with small Charges. 1798.

Nature.	Charge.	First Graze with different Elevations. 1 D.	2 D.	3 D.	4 D.	5 D.	6 D.	7 D.	8 D.	Extreme Range.
Pr. 12	10 oz.	199	290	390	785	597	716	695	788	From 800 to 1000
	1 lb.	280	416	729	777	966	1090	1054	1295	From 1200 to 1500
Pr. 6	5 oz.	111	222	376	432	618	625	650	788	From 800 to 1000
	8 oz.	277	401	754	826	925	980	1103	1100	From 1000 to 1300

N. B. The above was a 12-Pr. Medium, and a 6-Pr. Desagulier's. The Distances are given in Yards.

Long Ranges with Iron Ordnance.

Nature.	5 Deg.	45 Deg.	Length of Gun.	Carronades	5 Deg.
			Ft. In.		
32-Pr.	2300	5000	9 6	68-Pr.	1280
24 —	2200	4800	9 6	42 —	1170
18 —	2000	4500	9 0	32 —	1080
12 —	1850	4160	9 0	24 —	1050
9 —	1750	....	....	18 —	1000
6 —	1600	....	....	12 —	870

Ranges with Iron Guns taken from Experiment. 1813.

24-pr. Iron, 9 ft. 6 in.			24-pr. Iron, 6 ft. 6 in.			
Charge 8 lbs.			Charge 6 lbs.		Charge 4 lbs.	
Elevatⁿ	1st. Graze.	Ext. Range.	1st Graze.	Ext. Range.	1st Graze.	Ext. Range.
P. B.	....	....	258	1990	308	1823
1°	664	2311	560	2027	797	1853
2°	1028	2181	812	1900	1076	1833
3°	1300	2376	990	1930	1221	1947
4°	....	....	1190	1950	1465	1825
5°	....	....	1565	2230	1770	2117

Ranges with Iron Guns taken from Experiment. 1813.

Elevation	18-pounder, 9 feet.						18-pounder, Iron, 8 feet.					
	Charge 6lbs.		Char. 4½ lbs.		Charge 3lbs.		Charge 6 lbs.		Charge 4½ lbs.		Charge 3 lbs.	
	1st Graze	Ext. Range.	1st Graze	Ext. Range.	1st Graze	Ext. Range.	1st Graze.	Ext. Range.	1st Graze.	Ext. Range.	1st Graze.	Ext. Range.
P. B.	308	1823	267	1857	325	1620	275	1753	259	1883	254	1760
1°	797	2090	669	1853	577	1857	697	2107	675	1803	468	1763
2°	1076	2153	953	1833	695	1793	980	1960	877	1963	772	1700
3°	1221	2057	1074	1947	965	1723	1193	2160	1068	1883	916	1602
4°	1465	2037	1240	1825	1196	1773	1432	2048	1358	2077	1046	1705
5°	1770	2330	1773	2117	1517	2100	1670	2114	1643	2017	1390	2133

Effects of Case Shot from a Light 6-Pr.—Length 5 feet—Weight, 5 cwt. 3 qrs. 21lbs. against a Target 8 feet high, and 90 feet long.

Distance of Target.	Nature of Charge.	Elevation.	No. put into the height of 6 feet, or the height of *Infantry*.	No. put into the height of 8 feet, or the height of *Cavalry*.
yards.		deg.		
500	12 Balls, 8 oz. each, 3 in a tier, 1¼ lb. powder.	1	3	3
		1½	3	4
		2	3	4
400	Same Charge.	1	6	6
		1½	4	5
		2	4	5
300	Same Charge.	½	6	7
		1	3	3
		1½	4	6
400	34 Balls, 3 oz. each, 7 in a tier, 1¼ lb. powder.	P. B.	10	12
		½	9	10
		1	6	8
300	Same Charge.	P. B.	11	13
		½	12	15
		1	7	9

N. B. There were three rounds fired at each change, but they were all so nearly alike that it has been thought necessary to put down only one of them. 1802.

Abstract

Abstract of the Media of the First Graze of the following Iron Ordnance, carried on at Sutton Heath. 1810.

Elevation.	First Graze.							
	Garrison Carriage.					Iron Garrison Carriage.		
	24-Pr. of 9½ feet.			24-Pr. of 6½ feet.		18-Pounder of 9½ feet.		
	Charge.			Charge.		Charge.		
	lbs. 8	lbs. 6	lbs. 4	lbs. 6	lbs. 4	lbs. 6	lbs. oz. 4 8	lbs. 3
P. B.	297	248	265	221	288	385	350	308
1	720	661	581	582	479	881	630	503
2	1000	847	777	832	745	1060	887	757
3	1240	1213	925	1133	907	1340	1230	1058
4	1538	1472	1160	1308	1095	1603	1464	1250
5	1807	1590	1371	1545	1259	1730	1659	1365
6	2023	1939	1742	1741	1633	1965	1807	1655
7	2100	1897	1852	2273	1553	2192	2127	1803
8	2498	2288	2025	2250	2040	2398	2248	1980
9	2638	2545	2162	2204	2132	2562	2450	2100
10	2870	2673	2513	2562	2668	2632	2743	2355
15	3510	3350	—	3150	3020	3190	3150	3100
21	* 4000	—	—	* 3890	—	† 3610	—	—

* Hind Trucks off.

† Gun Carriage on Skids.

Table

TABLE

Shewing the Media of Three Rounds fired from a 24-Pounder Iron Gun, 9 feet 6 inches at the undermentioned Elevation and Charges. Eastbourne, 1813.

Elevation	Charge 8 oz. yards.	Charge 12 oz. yards.	Charge 1 lb. yards.	Charge $1\frac{1}{4}$ lb. yards.	Charge $1\frac{1}{2}$ lb. yards.	Charge $1\frac{3}{4}$ lb. yards.	Charge 2 lbs. yards.	Charge $2\frac{1}{4}$ lbs. yards.	Charge $2\frac{1}{2}$ lbs. yards.	Charge $2\frac{3}{4}$ lbs. yards.	Charge 3 lbs. yards.
P. B.	72	127	157	172	175	198	223	266	307	326	360
1°	114	152	186	212	343	378	412	498	567	619	685
2°	154	180	297	356	438	546	628	650	739	873	927
3°	171	224	356	427	610	709	774	829	920	982	1067
4°	181	311	458	646	746	803	936	1041	1105	1205	1307
5°	239	343	548	718	892	966	1045	1195	1266	1317	1397
6°	250	410	614	824	958	1110	1221	1392	1426	1482	1532
7°	269	423	668	888	999	1192	1397	1550	1613	1745	1816

Note.—The guns were loaded without wads, the shot being rammed home on the cartridge. The elevation was taken by the quadrant.

Ranges with Sea Service Iron Guns. 1796.

Nature of Guns, 32, 24, and 18-Pounders.			
Elevation.	Proportion of Powder.	Nature of Shot.	Range.
			Yards.
2°	1/3	With single shot to the first graze	1200
2°	1/4	Ditto ditto..........	1000
2°	1/4	2 shot, ranged close together, to	500
4°	1/2	Single shot	1600
4°	1/4	Ditto	1500
7°	1/2	Ditto	2150
7°	1/4	Ditto	2020
2°	1/4	One round shot, and one round of grape will range with effect together, to..	600
4°	1/4	One round of grape shot alone, to	1000
2°	1/4	One double-headed, or bar-shot, will range to the first graze	800

Ranges

Ranges with $5\frac{1}{2}$-Inch Shells from a 24-Pounder Iron Gun.
Length of Gun, $9\frac{1}{2}$ Feet.—Weight, 49 cwt. 26 lbs.

Elevation.	2 Pounds.			2 lbs. 8 oz.			3 Pounds.		
	Flight.	Range to First Graze.	Range to Extreme.	Flight.	Range to First Graze.	Range to Extreme.	Flight.	Range to First Graze.	Range to Extreme.
Deg.	Sec.	Yards.	Yards.	Sec.	Yards.	Yards.	Sec.	Yards.	Yards.
1	1	213	1139	$2\frac{1}{4}$	562	1456	1	277	1424
2	$1\frac{3}{4}$	384	1267	$1\frac{1}{2}$	442	1413	$1\frac{3}{4}$	526	1464
3	$2\frac{3}{4}$	565	1413	$2\frac{1}{2}$	647	1553	$2\frac{1}{4}$	740	1600
4	$2\frac{1}{4}$	750	1479	$3\frac{3}{4}$	896	1639	$3\frac{1}{2}$	880	1679
5	$3\frac{3}{4}$	836	1670	4	915	1510	5	1182	1733
6	4	896	1495	5	1140	1657	$6\frac{1}{4}$	1384	1787
7	$6\frac{1}{2}$	1180	1492	6	1205	1481	$6\frac{1}{4}$	1410	1749
8	$6\frac{3}{4}$	1305	1526	$6\frac{1}{2}$	1259	1544	7	1520	1744
9	$7\frac{1}{2}$	1329	1527	7	1341	1561	$7\frac{3}{4}$	1722	1938
$9\frac{1}{2}$	$6\frac{3}{4}$	1229	1453	..	....	....	$8\frac{1}{2}$	1748	1881

Ranges with $4\frac{4}{5}$ Shells from a 12-Pounder, Medium.

Elevation.	8 Ounces.			12 Ounces.			1 lb. 8 ozs.		
	Flight.	First Graze.	Extreme Range.	Flight.	First Graze.	Extreme Range.	Flight.	First Graze.	Extreme Range.
Deg.	Sec.	Yards.	Yards.	Sec.	Yards.	Yards.	Sec.	Yards.	Yards.
1	$1\frac{1}{2}$	156							
2	2	293		$2\frac{1}{2}$	350			707	
3	$2\frac{1}{2}$	363	From	$3\frac{1}{2}$	355	From		758	From
4	$3\frac{1}{2}$	462	800	4	679	1100		849	1400
5	4	587	to	$3\frac{1}{2}$	641	to		1075	to
6	4	621	1200	5	941	1300		1150	1600
7	$4\frac{1}{2}$	898		6	1020			1300	
8	5	781							

Ranges with French Brass Field Guns, with Round Shot.

Nature.	Charge.	Elevation. Lines of Tang^t Scale.	Elevation. Deg.	Elevation. Min.	Range in Toises.
12-Pr.	4 lbs.	L. M.	—	58	300
		2	1	3	350
		10	1	39	400
		14	1	49	450
		16	1	56	480
8-Pr.	2½ lbs.	L. M.	—	58	300
		6	1	24	350
		12	1	51	400
		16	2	8	450
		20	2	4	480
4-Pr.	1½ lbs.	L. M.	—	58	250
		4	1	20	300
		8	1	40	350
		12	2	—	400
		16	2	20	450
		18	2	40	480

The above in French weights and measures.

French light guns weigh about 150 lbs. for every pound weight of the shot.

MAHARAJA SERFOJI'S SARASWATI MAHAL

T

GUNPOWDER.—Proportion of the different Ingredients for making Gunpowder, by different Powers in Europe.

	England.	France.*	Portugal.	Spain.	Sweden.	Poland.	Italy.	Russia.	Austria.
Saltpetre..	75	75	78	76	75	80	76½	70	76
Sulphur ..	10	9½	11	13	9	8	12½	11½	12
Charcoal..	15	15½	14	11	16	12	12½	18½	11
Pounds...	100	100	103	102	100	100	101½	100	99

		Saltpetre.	Char[l].	Sulp[r].
* According to the fabrication of Monsr Champy, by order of the Committee of Public Safety	A.	76	15	9
	B.	77	17	7
	C.	80	15	5
Ancient, and resumed 18th August, 1808		75	12½	12½
For Mines		65	15	20

Experiments were made at Fère, in the 4th year of the Republic, under the direction of General Aboville, and at Vicennes, in the 6th year, under General Duterbie, &c. in order to obtain the comparative strength of the common irregular grained powder, and the round grained of Mr. Champy. The result at the first experiment was invariably in favour of the latter, with cannon, mortars, eprouvettes, and small arms; at the latter variable and nearly equal. For small arms, the round grained has the disadvantage of not inflaming so easily in the pan.

The ranges obtained by the simple mixture of the ingredients of gunpowder when well pulverized, were found to equal the medium ranges obtained by grained powder, and sometimes even to exceed them.

AIDE MEMOIRE.

Proofs of Powder.—The first examination of powder in the King's mills, is by rubbing it in the hands, to find whether it contains any irregular hard lumps. The second is by blasting 2 drachms of each sort on a copper-plate, and in this comparing it with an approved powder: in this proof it should not emit any sparks, nor leave any beads or foulness on the copper. It is then compared with an improved powder, in projecting an iron ball of 64 lbs. from an 8-inch mortar, with a charge of 2 ounces. The best cylinder powder generally gives about 180 feet range, and

pit 150; but the weakest powder, or powder that has been re-dried, &c. only from 107 to 117 feet.

The merchants' powder, before it is received into the King's service, is tried against powder of the same kind made at the King's mills; and it is received if it gives a range of one-twentieth less than the King's powder with which it is compared. In this comparison both sorts are tried on the same day, and at the same time, and under exactly the same circumstances.

The proof of fine grained, or musquet powder, is with a charge of 4 drachms from a musquet barrel, to perforate, with a steel ball, a certain number of ½-inch wet elm boards, placed ¾-inch asunder, and the first 39 feet 10 inches from the barrel: the King's powder generally passes through 15 or 16, and restoved powder from 9 to 12. The last trial of powder is by exposing about 1 pound of each sort, accurately weighed, to the atmosphere for 17 or 18 days; during which time, if the materials are pure, it will not increase any thing material in weight, by attracting moisture from the atmosphere.

In this exposure, 100 lbs. of good powder should not absorb more than 12 oz. or somewhat less than one per cent.

Powder Marks.—The different sorts of powder are distinguished by the following marks on the heads of the barrels.

No. $\frac{1}{2}$ L G	Cylinder	Marked in Red.
No. 2 S G	Cylinder	
No. 3 F G	Cylinder	

SA—The dust from No. 3, and FG cylinder.

RA—For rifle arms.

$\frac{4}{7}$ Cylinder, $\frac{3}{7}$ Restoved } mixed—Marked white L G.

L G or F G in blue, is powder made of pit-coal.

RS { No. $\frac{1}{2}$ L G, No. 3 F G } Marked in yellow, is restoved.

The *red* L G, F G, or S G, denotes powder entirely made of the cylinder charcoal, and is that which is now always used on service. The white L G being a mixed powder, is not so uniform as the other, and is therefore generally used in filling shells, or for any such other purposes as do not require much accuracy. All powder for service is mixed in proportions according to its strength, so as to bring it as much as possible to a mean and uniform force.

French Gunpowder.—The French proof-ball is of brass, and weighs 60lbs. French; the diameter of the mortar 7 inches 9 points, or $\frac{3}{4}$ of a line, and has one line of windage.

 The

The chamber holds exactly 3 ounces; and their best powder must give a range of 90 toises, and their restoved powder a range of 80 toises, to be received into the service. But the powder they now make, when new, will give a range of 100 and 120 toises; and Mr. Lombard calculates all his tables from experiments made with powder, giving 125 toises with the eprouvette. The above dimensions and weights are all of French standard.

A grain of gunpowder, if it is exactly spherical, when fired, spreads its flame all round it to a distance of 8 times its diameter; consequently, the diameter of the inflamed globe is equal to 16 times that of the grain; from which it is calculated, that powder, when reduced by the inflammation into gas, occupies a space 4000 times greater than when in grain, or as 1 is to the cube of 16=4156.

GUN-METAL—is composed of 8 or 10 lbs. of tin to 100 lbs. of copper. The largest proportion of tin is used for mortars. A cubic foot of gun-metal weighs 549 lbs. that of cast iron, 464 lbs. The average price of brass ordnance above 10 cwt. is £180. per ton; of heavy cast iron ordnance, £18. to £20. per ton; of light brass ordnance, £200. per ton; of iron carronades, £26. per ton.

HOR.

HAIR-CLOTH.—Weight, 30 lb.—length, 75 feet—breadth, 11 feet.

HAND-BARROW.—Weight, 13 lbs.—length, 5 feet 4 inches.

HAND-SPIKES.—Common, weight, 11 lbs.—length, 6 feet—diameter at top, 1¼ inch; bottom, 3 inches square—length of the square, 2 feet.

HARNESS.—For men, one set, 26 lbs. length, 12 feet; wheel harness for a pair of horses, such as is used in the service of artillery, about 1 cwt.

HORSES.—An allowance of 3 feet is generally made for the breadth of each horse standing at picket, and about 9 feet for the length of a horse.

A light dragoon horse, mounted and accoutered complete, carries about 2 cwt. 1 qr. and 14 lbs, without forage.

Horses in the service of artillery should not be made to draw above 3 cwt. each, besides the weight of the carriage.

Horses

Horses for this service should never be lower than 14½ hands. The contractor is obliged to furnish them of this height for government. A horse is generally supposed equal to five men.

Military horses *walk* about 400 yards in 4⅓ minutes.

Trot the same distance in 2 minutes 3 seconds, and *gallop* it in about 1 minute.

With great burthens, less weight must be allowed for each horse to draw, than with medium burthens; as it cannot be supposed that, of a team of 8 horses, the leader can draw so much as the horses nearer the carriage; and this disadvantage must encrease as the team lengthens.— A team of

4 horses may draw	6 cwt. each.	—Total	24 cwt.
6 ditto ———	5 do.	do. ———	30 do.
8 ditto ———	4½ do.	do. ———	36 do.
12 ditto ———	4 do.	do. ———	48 do.

} including the carriages.

See also the word *Load*.

It is usual in heavy carriages to reckon all their weight exceeding 12 cwt. as part of the load.

Horses allowed for drawing Field Artillery Carriages.

All the horse artillery carriages are drawn by 4 horses each, except 12-prs. and 9-prs. which have 6 each.

On actual service 8 horses are generally allowed to 12 and 9-prs. where the roads are bad and country mountainous.

Park

Park Carriages.—12-pr. medium, 9-pr. and 6-pr. heavy, 6 horses each—6-pr. light, and 5½ howitzer, upon the new construction, are allowed each 4 horses.

Limber carriage ....4 horses.
Ammunition waggon, new pattern ....4 ditto.
Ditto ditto, Flanders pattern......4 ditto.
Cavalry forge waggon, new pattern ....4 ditto.
Forge, with limber, new pattern ....4 ditto.
Wheel carriage..........................4 ditto.
Ball cartridge waggons ....4 ditto.

HOWITZERS.

Iron Howitzers.			
Nature.	Weight.		
	cwt.	qrs.	lb.
10-inch.	39	3	0
8-inch.	20	0	0
5½-inch.	15	0	0
	13	0	0

HOWITZERS.

HOWITZERS.—Dimensions and Weight of Old Pattern Brass Howitzers.

Nature.	Length.	Weight.	Length of Bore.	Chamber. Length.	Chamber. Diameter. at top.	Chamber. Diameter. bottom	Chamber. Powder contained in
Inch. diam.	feet. inch.	cwt. qrs. lbs.	Inches.	inches.	inches.	inches.	lbs. oz.
10	3 11½	25 3 14	29·9	12·6	5·776	4·12	7 0
8	3 1	12 3 12	24·7	8·61	4·6	3·40	3 8
5½ Heavy.		10 0 0					3 0
5½ Light.*	2 2¾	4 0 2	18·47	6·02	3·2	2·45	1 0
4⅖	1 10	3 0 13	15·21	4·52	2·7	2·24	0 8

* The light 5½inch howitzer, English, is, of all other pieces of ordnance, the most uncertain in its range and direction, owing to the shortness of the piece, and is now superseded by the new 12-pr. brass howitzer; but as some few may still be left in service, the details respecting it are given. Gen. L'Espinasse makes the same objection to the French howitzer of 6-inches, and gives the preference to the Austrian 5½-inch, which is lighter and longer than the French 6-inch: he recommends the carriage to be of such a construction, that, by taking off the wheels, it may be made use of as a mortar. The length of the Austrian 5½-inch howitzer is 3 feet 3 inches English measure.

French Howitzers, in their own Weights and Measures.

Diameter.	Length. Ft. In.	Weight. lbs.	Full Charge. lbs. oz.
8 inches	2 3	1110	1 12
6 inches	2 3	670	1 12

Austrian 5½-inch howitzer, or 7-pr.—length, 6 calibers—weight, 573 lbs.—charge, ⅛ to ⅕ of the weight of the shell.

General Millar's New Howitzers.

Nature.	Weight.			Length.		Length in Calibers.	Charge.	
	cwt.	qrs.	lb.	ft.	in.		lbs.	oz.
10-inch iron .	39	2	2	5	0	6	7	0
8-inch ditto	20	3	7	4	0	6	4	0
24-pr. brass . .	13	0	0	4	9	10	2	8
12-pr. brass . .	6	0	0	3	$9\frac{1}{2}$	10	1	8

Wooden bottoms are fixed to common shells for the brass howitzers.

Table containing the Natures of Howitzers used by different Powers in Europe.

Nations.	Natures.	Shells.	Nations.	Natures.	Shells.
		weight			
Prussian	25-Pr.*	26 lbs.	English	$4\frac{2}{5}$-Inch or 4-Pr.	8 lbs.
	10 ——	27		$5\frac{1}{2}$-Inch. or 8-Pr.	16
	7 ——	14		8-Inch or 23-Pr.	46
Danish	18 ——	36	French	6-Inch. or 12-Pr.	23
	10 ——	20		8-Inch or 22-Pr.	43
Saxon	16 ——	32			
	8 ——	16			
Hanover	30 ——	61			
	16 ——	33			

* See the word *Shell* for the principle on which the Germans class them in pounders.

Ranges

Ranges with a light 5½-Inch Howitzer. 1798.

Elevation.	Four Ounces. Flight.	Four Ounces. Range to First Graze.	Four Ounces. Extreme Range.	Eight Ounces. Flight.	Eight Ounces. Range to First Graze.	Eight Ounces. Extreme Range.	Twelve Ounces. Flight.	Twelve Ounces. Range to First Graze.	Twelve Ounces. Extreme Range.	One Pound. Flight.	One Pound. Range to First Graze.	One Pound. Extreme Range.
Deg.	Sec.	Yards.		Sec.	Yards.		Sec.	Yards.		Sec.	Yards.	
P.B.			From 400 to 600 Yards.	1	96	From 700 to 1000 Yards.	1½	140	From 1000 to 1350 Yards.	1	159	From 1100 to 1400 Yards.
1	1	66		1½	143		2	334		1	225	
2	1	85		1½	184		2	351		2	490	
3	1½	100		2	258		2½	506		3	668	
4	1½	110		2½	307		3	500		4	728	
5	2	115		2½	376		3	509		5½	918	
6	2	168		3	408		3½	581		5	823	
7	2	194		3½	529		5	872		6	975	
8	2½	226		4½	620		6½	975		7	1044	
9	2½	282		5	645		7	911		8	1049	
10	2½	279		5½	642		7	1021		8	1104	
11	2½	260		5½	797		7½	1177		8	1173	
12	3	315		5	715							

Ranges with a heavy $5\frac{1}{2}$-Inch Howitzer. 1793.

Elevation.	Two Pounds.				Three Pounds.	
	Flight	First Graze.	Extreme Range.	Flight.	First Graze.	Extreme Range.
Degrs.	Sec.	Yards.	Yards.	Sec.	Yards.	
1	2	453		3	479	
2	4	595		5	722	
3	4	666		5	921	
4	5	847	From	5	1000	From
5	5	957	1400	7	1325	1400
6	7	1173	to	8	1530	to
7	9	1449	1900	9	1577	2000
8	8	1355		9	1721	
9	8	1585		9	1801	
10	10	1853		9	1791	
11	9	1793		12	1013	
12	10	1686				

Ranges with common Shells from a 24 and 12-Pounder Brass Howitzer, Nov. 1819.

24-Pounder Howitzer.				12-Pounder Howitzer.		
Range.	Charge	Elevat^n	Fuze.	Charge	Elevat^n	Fuze.
700	$2\frac{1}{2}$	2·10	·45	$1\frac{1}{4}$	2·50	·46
900	$2\frac{1}{2}$	2·50	·56	$1\frac{1}{4}$	4·10	·57
1200	2	4·0	1·	$1\frac{1}{4}$	5·30	1·2

Charges

Charges of Powder for Brass Howitzers.

Nature.	Common Shells and Case.	Service Charges.		Scaling.
		Carcasses	Spherical Case.	
	lbs. oz.	lbs. oz.	lbs. oz.	lbs. oz.
10-Inch	7 ..	7 ..	7 ..	3 8
8-Inch	3 8	3 8	3 8	1 12
$5\frac{1}{2}$-Heavy ..	2 ..	2 ..	2 ..	1
$5\frac{1}{2}$-Light ...	1 ..	7 ..	1 ..	.. 8
$4\frac{2}{5}$-Inch	.. 8	.. 8	.. 8	.. 4
24-Pounder ..	2 8	2 8	2 8	
12-Pounder ..	1 4	1 4	1 4	

INS

INSTRUCTIONS.—For the care and preservation of iron ordnance, clear the exterior and interior from rust and dirt with the circular spring scraper, the bottom of the bore with the tool for that purpose, and the vent with a square rimer; after which the bore must be well brushed out. To lacquer the bore, fix a common painter's brush vertically on a long handle. When the first coat of lacquer is dry, apply a second. The bottom of the bore is lacquered by a brush fixed horizontally on a long handle. The exterior of the piece to be well scraped with an old sea service sword, or steel tool. When the rust will not give way, it should be slightly hammered, and afterwards brushed off. Two coats of anti-corrosion are then laid on. The guns before coating should be placed where they are to remain a short time; when skidded they should be laid under metal, *i.e.* with their muzzles rather lower than the breach, so as to prevent rain or dirt from lodging in the bores, which should be swept out occasionally. Guns should be coated and lacquered about every fourth year. The above directions apply equally to guns mounted on works, and those skidded. For the composition of anti-corrosion and lacquer, see the word *Composition.*

INVESTMENT.—The investment of a fortress previous to undertaking the siege, should be formed by the simul. taneous march of all the columns, destined for that service, which must arrive by different routes at the same time, so as to cut off suddenly all communication with the surrounding country. The number of these columns, their strength and composition, must be regulated by the situation and strength of the garrison. If the place is of considerable extent, and situated in an open country, more troops will be required, and a greater proportion of cavalry will be requisite. If situated in a marshy and irregular country, subject to inundation, less troops of every kind will suffice. If the situation is mountainous, woody, and intersected with ravines, the number of light infantry must be increased, and that of cavalry diminished. As the columns which are charged with the investment arrive, they must take up their ground as near to the place as possible, without being under its fire; and their advanced guards of light troops, profiting by the surprise of the enemy at their first appearance, must push on rapidly, and bring off any workmen, or cattle, or any person likely to give information.

If the commandant of the place, foreseeing the moment of its investment, should have occupied the avenues which lead to it, the advanced guards must drive in all such posts as are too far from the fortress to be sustained.

The troops of the columns of investment, on their arrival, should

should be divided into platoons, forming a double cordon round the place; the first of these cordons should face it, whilst the second faces towards the country. The infantry occupy the houses, gardens, woods, roads, bridges, heights, and ravines; the cavalry is distributed in the open country, in the rear, and should patrole a considerable distance.

If the enemy should have any corps in the field, stationed in the vicinity, a corps of observation must be formed, to prevent them from falling unawares on the cordon of investment.

Every evening, at night-fall, parties must be pushed forward from the cordon facing the fortress, so as to shut up the garrison as much as possible, and to prevent any person going in or out. At day-light these parties must be withdrawn, in order to avoid the fire of the place.

The officers of engineers, and those of the staff, appointed to lead the columns, must be sent forward frequently to make reconnoissances, which they must do as privately and as rapidly as possible.

Noizet St. Paul.

LEV

LEVELLING.—*Table shewing the Difference between the True and Apparent Level.*

Distance.	Difference of level.	Distance.	Difference of level.	Distance.	Difference of level.	Distance.	Difference of level.
Yds.	Inch.	Yds.	Inches.	M.	Ft. Inch.	Mls.	Ft. Inch.
100	0·026	1000	2·570	¼	0 0½	7	32 6
200	0·103	1100	3·110	½	0 2	8	42 6
300	0·231	1200	3·701	¾	0 4½	9	53 9
400	0·411	1300	4·344	1	0 8	10	66 4
500	0·643	1400	5·038	2	2 8	11	80 3
600	0·925	1500	5·784	3	6 0	12	95 2
700	1·260	1600	6·580	4	10 7	13	112 2
800	1·645	1700	7·425	5	16 7	14	130 1
900	2·081			6	23 11	15	150
						16	175

This table will answer several useful purposes.

First.—*To find the height of the apparent level above the true, at any distance.*—If the given distance be contained in the table, the correction of level is found in the same line with it; but if the exact distance be not found in the table, then multiply the square of the distance in yards by 2·57, and divide by 1,000,000, or cut off 6 places on the right, for decimals; the rest are inches; or multiply the

square

square of the distance in miles, by 66 feet 4 inches, and divide by 100.

Second.—*To find the extent of the visible horizon, or how far can be seen from any given height, on a horizontal plane, as at sea,* &c.—The height of the observer's eye above the horizon being known, the extent of his visible horizon is found in the column opposite, under the word *Distances.*

Third.—*To find the distance of any object when it first comes in sight, its height being known.*—For the distance of any object will be the extent of the visible horizon of the observer, added to the visible horizon of the point he observes.—It is necessary in this case for the observer to know only the height of that part of the object which is kept from his view, by the curvilinear figure of the globe. —Knowing the distance of an object, its height may be found in the same manner.

If the height or distance exceeds the limits in the table; then, first, if the distance be given, divide it by 2, 3, or 4, till the quotient comes within the distances in the table; then take out the height answering to the quotient, and multiply it by the square of the divisor for the height required. But when the height is given, divide it by one of these square numbers, 4, 9, 16, 25, &c. till the quotient come within the limits of the table, and multiply the quotient by the square root of the divisor.

LIGHT-BALLS.—See *Composition.*—which must be well melted,

melted, and poured into the shells, or, when warm, put in by small bits, and set hard in the shell, by means of a round ended stick well greased.

Table of Wooden Formers, for Light or Smoke Balls, in Inches and Parts.

Nature.	Diameter of the Balls.	Thickness of Paper, complete.	Diameter of the Guages.	Diam. of the Fuze Hole.	
				At Top.	At Bottom.
13-Inch	11·300	1·450	12·750	1·837	1·696
10-Do.	8·600	1·150	9·750	1·570	1·450
8-Do.	6·650	1·100	7·750	1·325	1·227
$5\frac{1}{2}$-Do.	4·750	·790	5·140	·894	·826
$4\frac{2}{5}$-Do.	3·750	·650	4·600	·832	·796

LOAD.—Artillery carriages, or waggons, are frequently loaded with 20 cwt. for 4 horses. This, however it may answer on an English road, is a great deal too much for general service. No doubt a carriage of one construction will travel easier than of another, with the same weight; and where the mechanical advantage thus gained is greatest, the heaviest weight may be put, with the same number of horses; but in the carriages usually made for the service of artillery, 4 cwt. per horse, besides the weight of the carriage, is the utmost they ought to be allowed to draw.

The

The French ammunition waggons, which are drawn by 4 horses, are always charged with 1200 pounds only.

Men used to bear loads, such as porters, will carry from 150 to 250 pounds.

A horse will carry about 300 lbs. and a mule about 250 lbs. —See also the word *Horses*.

MAG

Magazines.—The present practice is not to make large powder magazines for batteries, but to disperse the barrels of powder, or cartridges, *here* and *there* in small magazines, about 6 or 7 fathoms, in the rear of the battery; as it appears better to lose a small quantity from time to time, than to run the risk of the whole being destroyed, by a single shell falling into the magazine. These small magazines or entrenchments, will hold about one or two tons of powder; and are about 8 or 9 feet square. They ought to be well covered from the fire of the place, and always in the rear of one of the merlons. When they cannot be sunk in the ground, they should be secured by sand-bags or gabions. They should be made with attention, as should the communication from them to the battery. Two magazines of this kind will be required for a battery of six pieces.

Permanent Powder Magazines.—According to Vauban's plan, powder magazines are commonly made 10 fathoms long, and 25 feet wide, in the clear. The foundation of the longest sides, is 9 or 10 feet thick, and 6 feet or more deep, according to the nature of the ground. The side walls raised upon these are 8 or 9 feet thick; and if there

is

is not to be an upper story, 8 feet will be sufficient height above the foundation. By this means the flooring may be raised above the ground, free from damp, and there will remain 6 feet from the floor to the spring of the arch. The arch is formed of layers of bricks, arched one over the other; and ought to be 3 feet thick at top. The exterior surface of the arch terminates with an angle at the top, like a roof; which angle must be of such magnitude as to make a thickness of 8 feet over the key-stone of the arch. The foundation of the gable ends is 5 feet thick, and the same depth as the sides: these ends are built up 4 feet thick, from the foundation to the top of the roof. The long sides are supported by counterforts, 6 feet thick and 4 feet long; and placed 12 feet asunder. The ventilators are placed, one in the centre of each space between the counterforts, and are made with a die across them of one-half foot. These ventilators are also closed with plates of iron. The magazine is lighted by a window in each end, high up, which is opened and shut by means of a ladder. These windows are secured, each by two shutters, made of plank 2 or 3 inches thick; and the outer one covered with sheet iron, and both fastened with strong bolts. The entrance to the magazine is closed by two doors, one of which opens inwards, and the other outwards; the outward one is covered with sheet iron. The entrance of the magazine should, if possible, be placed towards the south. A wall of 1½ feet thick, and 10 feet high, is built round the magazine,

magazine, at 12 feet distance. A magazine of the above dimensions will contain about 94,800 lbs. of powder, in piles of 3 barrels each; for a greater number piled above each other destroys the barrels, damages the powder, and occasions accidents.

MATCH.—The slow match used by the English is made by contract: one yard of it will burn about eight hours. The French slow match is usually made by soaking light twisted white-rope for three days in a strong lye. It burns about 3 feet in 6 hours.

Slow match was made at Gibraltar, during the last siege, in the following manner: eight ounces of salt-petre were put into a gallon of water, and just made to boil over a slow fire; strong blue paper was then wetted with the liquor, and hung to dry. When dry, each sheet was rolled up tight, and the outward edge pasted down, to prevent its opening: half a sheet, thus prepared, will burn three hours.

Quick Match.

Compositions.

Worsted Match.		*Cotton Match.*	
Worsted	10 oz.	Cotton	1 lb. 12 oz.
Mealed powder	10 lb.	Saltpetre	1 8
Spirits of Wine	3 pints.	Mealed powder	10 —
Water	3 ditto.	Spirits of wine	2 quarts.
Isinglass	½ pint.	Water	3 pints.

The

The worsted or cotton must be laid evenly in an earthen or other pan, and the different ingredients poured over it, and about half the powder: being left a short time to soak, it is afterwards wound smoothly on a reel, and laid to dry: the remaining half of the powder is then sifted over it; and it is ready for use when dry.

Note.—The French have lately made their slow match by soaking the rope in a solution of sugar of lead and rain water: in the proportion of three-fourths of an ounce of sugar of lead to one pint of water: and this they esteem as preferable to the old sort. This method of making slow match, invented by La Martilliere, Lieutenant-Colonel in the French Artillery, in 1782, burns five inches in an hour.

MARCHING.—The Quick Step—108 paces per minute, each of 30 inches, making 270 feet per minute—450 yards in five minutes, or 3 miles 120 yards in an hour.

Wheeling Step—120 per minute, of 30 inches each; making 300 feet per minute.

Side Step—12 inches—75 per minute.

Slow March—75 per minute, 30 inches each.

Double March—150 per minute of 36 inches; 750 yards in 5 minutes, or 5 miles 200 yards in an hour.—*See Pendulum.*

The usual rate of marching for cavalry is 17 miles in 6 hours; but this may be extended to 21, or even 28 miles. in that time. D'ANTONI.

Rates to be paid for Carriages on the March.

One shilling per mile for every carriage.	with 5 horses, or with 6 oxen, or with 4 oxen and 2 horses:

nine-pence per mile for any cart with 4 horses, and so in proportion for less carriages; or a further sum, not exceeding 4d. per mile for every carriage with 5 horses, or with 6 oxen, or with 4 oxen and 2 horses; or 3d. per mile for every cart with 4 horses; and so in proportion for less carriages, as the same shall be fixed and ordered by the justices of the peace. The waggon, &c. not to carry more than 30 cwt.

Regular ferries are only to be paid for on the march at half the ordinary rate.

Marching Money—Inn-keepers are obliged to furnish troops on the march with one meal per diem and small-beer, for the day of their marching in, and two days afterwards; unless one of the two days be a market day. For which the publican is to receive one shilling.

Cavalry receive....	1	1	Marching money, out of which the publican is paid.
Infantry..........	1	3	

Long Measure.

12 Inches	make	1 Foot.
3 Feet		1 Yard.
5½ Yards		1 Pole, or perch.
40 Poles		1 Furlong.

8 Furlongs

8 Furlongs	$\frac{3}{4}$ Mile.
4 Inches	1 Hand.
6 Feet	1 Fathom, or toise.
3 Miles	1 League.
60 Nautical, or geographical miles, or 69¼ statute miles,	1 Degree.

Square Measure.

144 Square inches....make	1 Square foot.
9 Square feet	1 Square yard.
30¼ Square yards	1 Square pole
40 Square poles	1 Square rood.
4 Square roods	1 Square acre.

Solid, or *Cubic Measure.*

1728 Cubic inches....make	1 Cubic foot.
27 Cubic feet	1 Cubic yard.
251 Cubic inches	1 Gallon, wine measure.
281 Ditto	1 Gallon, bear measure.
168⅗ Ditto	1 Gallon, dry measure.

Dry Measure.

8 Pints..........make	1 Gallon.
2 Gallons	1 Peck.
4 Pecks	1 Bushel.
4 Bushels	1 Coom.
2 Cooms	1 Quarter.
5 Quarters	1 Wey.
2 Weys	1 Last.

x 2 *Avoirdupois*

Avoirdupois Weight.

16 Drams ....make......1 Ounce.
16 Ounces ....1 Pound.
28 Pounds ....¼ of a hundred.
4 Quarters................1 Hundred.
20 Hundred................1 Ton.
14 Pounds.................1 Stone.

French Weights and Measures.

The toise is commonly used in France for military purposes, and is divided into 6 feet: each foot 12 inches; each inch 12 lines; each line 12 points.

The pace is usually reckoned at 2½ feet.

Poids de Marc, ou de Paris.

24 Grains..........make......1 Denier.
3 Denier ....1 Gros.
8 Gros........................1 Ounce.
8 Ounces.....................1 Marc.
2 Marcs ....1 Pound.

The French have lately formed an entire new system of weights and measures. The following short account of them, and their proportion to the old weights and measures of France, and those of English standard, is extracted from *Nicholson's Nat. Philosophy.*

Proportions of the measures of each species to its principal measure of unity.	First part of the name which indicates the proportion to the principal measure of unity	Principal Measures, or Unities.				
		Length.	Capacity.	Weight.	Agrarian.	For Firewood.
10·000 1·100 100 10 0 0·1 0·01 0·001	Myria- Kilo- Hecto- Deca- ——— Deci- Centi- Mili-	-Metre.	Litre.	Gramme.	Are.	Stere.
Proportion of the principal measures between themselves, and the length of the meridian.		10,000,000th part of the dist. from the pole to the equator.	A decimetre cube.	Weight of a centimetre cube of distilled water.	100 square metres.	One cubic metre.
Value of the principal measures in the ancient French measures		3 feet 11 lines and ½ nearly.	1 pint and $\frac{1}{20}$ or 1 litron and ¾ nearly.	18 grains and 841000 parts.	2 square perches des eaux et foret.	1 demi voie, or ¾ of a cord des eaux et foret.
Value in English measures		Inches 39·383.	61·083 inch, which is more than the wine and less than the beer quart.	22,966 grains.	11·968 square yards.	

Reduction of the old French Weights and Measures to English: and the contrary.

1st. To reduce English avoirdupois to Paris weight.

The avoirdupois pound of 16 ounces, or 7000 troy grains.	= 8538	Paris grains.
The ounce	=533·6250	

2d. To reduce Paris running feet or inches into English, multiply by .... — English running feet or inches into Paris, divide by	1·065977
3d. To reduce Paris cubic feet or inches into English, multiply by .... — English cubic feet or inches into Paris, divide by	1·211278
4th. To reduce the Paris pint to the English, multiply by .... — To reduce the English pint to the Paris, divide by	2·0171082

LAVOISIER CH.

German Measures.—The Rhinland rood is the measure commonly used in Germany and Holland, and in most of the northern states, for all military purposes. It is divided into 12 feet. The Rhinland rood is sometimes divided into tenths, or decimal feet, and the pace is made equal to 2 decimal feet, or two tenths of a rood.

Proportion between the English Weights and Measures, and those of the principal Places in Europe.

Places.	Foot in Parts.	Pound in Parts.	Places.	Foot in Parts.	Pound in Parts.
London	1000	100	Prague	1026	106
Paris	1068	108	Copenhagen ..	965	94
Amsterdam ...	942	93	Nuremburgh ..	1006	94
Rhynland	1033	96	Bavaria	954	
Antwerp	946	98	Vienna	1053	83
Lovaine	958	98	Madrid	1001	99
Middleburgh ..	991	98	Toleda	899	100
Strasburgh ...	920	93	Bologne	1204	127
Bremen	964	94	Naples	861	
Cologne	954	97	Florence	....	123
Frankfort	948	93	Genoa	....	142
Leipsig	....	117	Mantua	1569	143
Hamburgh	....	95	Turin	1062	
Venice	1153	151	Dantzig	944	119

Measures—for gunpowder.

Diameters and Heights of Cylindric Powder Measures, holding from 1 *to* 15 *Ounces.*

Ounces.	0	1	2	3	4	5
0	0	1·256	1·583	1·811	1·994	2·148
1	2·706	2·793	2·876	2·953	3·027	2·098

Diameters.

Diameters and Heights of Cylindric Powder Measures, holding from 1 to 15 Pounds.

Pounds	0	1	2	3	4	5
0	0	3·165	3·988	4·565	5·024	5·412
1	6·890	7·039	7·245	7·442	7·628	7·805

The above is in inches and decimals.

To find how much powder will fill a rectangular box—find the content of the box by multiplying the length, breadth, and depth, together; then divide by 30 for the pounds of powder.

To find how much powder will fill a cylinder—multiply the square of the diameter by the length; then divide by 38·2 for the pounds of powder.

To find the size of a cubical box to contain a given weight of powder—multiply the weight in pounds by 30, and the cube root of the product will be the size of the box.

To find what length of a cylinder will be filled by a given weight of powder—multiply the weight in pounds by 38·2, and divide the product by the square of the diameter in inches, for the length.

MECHANICS.—The whole momentum or quantity of force of a moving body is the result of the quantity of matter, multiplied by the velocity with which it is moved; and

and when the product arising from the multiplication of the particular quantities of matter in any two bodies, by their respective velocities, are equal, their momentum will be so too. Upon this easy principle depends the whole of mechanics; and it holds universally true, that when two bodies are suspended on any machine, so as to act contrary to each other, if the machine be put in motion, and the perpendicular ascent of one body multiplied into its weight, be equal to the perpendicular descent of the other, multiplied into its weight, those bodies, how unequal soever in their weights, will balance each other in all situations: for, as the whole ascent of the one is performed in the same time as the whole descent of the other, their respective velocities must be as the spaces they move through; and the excess of weight in one is compensated by the excess of velocity in the other. Upon this principle, it is easy to compute the power of any engine, either simple or compound; for it is only finding how much swifter the power moves than the weight does, (*i. e.* how much further in the same time,) and just so much is the power encreased by the help of the engine.

The simple machines usually called mechanic powers, are six in number, viz. the *lever*, the *wheel* and *axle*, the *pulley*, the *inclined plane*, the *wedge*, and the *screw*.

There are four kinds of *levers:* 1st. Where the prop is placed between the weight and the power.—2d. Where the prop is at one end of the lever, the power at the other, and the

the weight between them.—3d. Where the prop is at one end, the weight at the other, and the power applied between them.—4th. The bended lever, which differs from the first in form, but not in property.

In the 1st and 2d kind, the advantage gained by the lever, is as the distance of the power from the prop, to the distance of the weight from the prop.—In the 3d kind, that there may be a balance between the power and the weight; the intensity of the power must exceed the intensity of the weight, just as much as the distance of the weight from the prop exceeds the distance of the power from the prop. As this kind of lever is disadvantageous to the moving power, it is seldom used.

Wheel and *axle*.—Here the velocity of the power is to the velocity of the weight, as the circumference of the wheel is to the circumference of the axle.

Pulley.—A single pulley, that only turns on its axis, and does not move out of its place, serves only to change the direction of the power, but gives no mechanical advantage. The advantage gained in this machine, is always as twice the number of *moveable* pullies; without taking any notice of the *fixed* pullies necessary to compose the system of pullies.

Inclined plane.—The advantage gained by the inclined plane, is as great as its length exceeds its perpendicular height. The force wherewith a rolling body descends upon an inclined plane, is to the force of its absolute gravity, as the height of the plane is to its length.

Wedge.—This may be considered as two equally inclined planes, joined together at their bases. When the wood does *not* cleave at any distance before the wedge, there will be an equilibrium between the power impelling the wedge, and the resistance of the wood acting against its two sides; when the power is to the resistance, as half the thickness of the wedge at the back, is to the length of either of its sides; because the resistance then acts perpendicular to the sides of the wedge: but when the resistance on both sides acts parallel to the back, the power that balances the resistance on both sides will be, as the length of the whole back of the wedge is to double its perpendicular height. When the wood cleaves at any distance before the wedge, (as it generally does) the power impelling the wedge will be to the resistance of the wood, as half the length of the back is to the length of either of the sides of the cleft, estimated from the top, or acting part of the wedge.

Screw.—Here the advantage gained, is as much as the circumference of a circle described by the handle of the winch, exceeds the interval or distance between the spirals of the screw.

There are few compound engines but what, on account of the friction of parts against one another, will require a third part more power to work them when loaded, than what is required to constitute a balance between the power and the weight.

FERGUSON'S *Nat. Philosophy.*

MILE.

MILE.—Itinerary table of miles, yards, and leagues.

	Engh. Yds.
Arabia—a mile is equal to	= 2148
Bohemia	13137
Brabant	6082
Burgundy	6183
China—a lis is equal to	629
Denmark—a mile	8244
England—statute mile	1760
Ditto—geographical ditto	2025
Flanders—mile	6869
France—astronomical league	4860
Ditto—marine league	6075
Ditto—legal ditto of 2000 toises	4263
Germany—geographical mile	8101
Ditto—long ditto	10126
Ditto—short ditto	6859
Hamburgh—mile	8244
Hanover	11559
Hesse	10547
Holland	6395
Hungary	9113
Ireland	3038
Italy	2025
Oldenburg	10820
Poland—long mile	8101

	Engh. Yds.
Poland—short mile is equal to ....=	6075
Portugal—a league	6760
Prussia—a mile	8460
Rome—ancient mile of 8 stadii................	1612
Ditto—modern ditto	2025
Russia—a verst	1167
Saxony—a mile	9905
Scotland	1984
Silesia	7083
Spain—leagues, common, of 8000 varas	7416
Spain—ditto, legal, of 5000 varas............	4635
Swabia—a mile	10126
Sweden	11700
Switzerland.................................	9153
Turkey—a berri	1826
Westphalia—a mile..........................	12151

Universal Cambist.

MINE.—The excavation formed by the blowing up of a mine, is found by experiment to be nearly a paraboloid. It was formerly supposed that the diameter of the *entonnoir*, or excavation, was always equal to only double the line of least resistance; but experiments have proved, that the diameter of the excavation may be increased to six times the line of least resistance; and that the diameter of the globe of compression may be increased to eight times that line;

line; this is called the *maximum* of a mine, or the greatest effect that can be produced by a globe of compression. In any mine intended to produce an effect within this extent, the effects will be nearly as the charges.

The globes are to each other as the cubes of their radii. Their radii are the hypothenuses of right-angled triangles, of which the line of least resistance, and the semi-diameter of the excavation, are the other two sides. Therefore, to find the charge to produce any required diameter of excavation, the following will be the rule, the radius being found as above:

As the cube of the radius of the globe of compression in the following table, (having the same line of least resistance as the required globe,)
Is to the cube of the radius of the required globe;
So is the charge corresponding in the following table;
To the charge required.

Table for the Charges of Mines according to VALIERE.

Line of least resistance.	Charge for the Mine.		Line of least resistance.	Charge for the Mine.	
Feet.	lbs.	ozs.	Feet.	lbs.	ozs.
1	0	2	21	868	3
2	0	12	22	998	4
3	2	8	23	1140	10
4	6	—	24	1296	—
5	11	11	25	1558	9
6	20	4	26	1647	12
7	32	2	27	1815	4
8	48	—	28	2058	—
9	68	5	29	2286	7
10	93	12	30	2530	4
11	124	12	31	2792	4
12	162	—	32	3072	—
13	205	15	33	3369	1
14	257	4	34	3680	12
15	316	4	35	4019	8
16	384	—	36	4374	—
17	460	9	37	4748	11
18	546	12	38	5144	4
19	643	—	39	5561	2
20	750	—	40	6000	—

This table is calculated upon a supposition that the excavation of the mine is a paraboloid, having a base double the line of least resistance; and that 10 lbs. 10 ozs. of powder is sufficient for raising one cubic fathom of earth. By the rule above given may be found the charge for any mine, that shall only shake the ground, without making any

any excavation, by making the line of least resistance of the required globe only equal to the radius of the globe of compression.

The charges thus found by means of this table, being only for one nature of soil, viz. light earth and sand, (that for which the table is calculated) must be augmented according to the following table of VAUBAN, by one, four, five, seven, or nine-elevenths of the charge found.

Table of the Quantity of Powder required to raise a Cubic Fathom, according to the Soil.

1	Light earth, mixed with sand	11 pounds.
2	Common earth	12
3	Strong sand	15
4	Clay, or fat earth	16
5	Old and good masonry	18
6	Rock	20

The following rule is, however, laid down by BELIDOR, and generally adopted, if it be intended that the mine shall produce its maximum or greatest effect:—Multiply the line of least resistance, expressed in feet, by 300, the product will be the charge in pounds.

In making mines of any kind, the following remarks may be of service.

The best form for the chamber would be spherical; but from the difficulty of its construction, it is always made a cube,

cube, of one inch larger dimensions than the box to contain the powder.

The chamber must not be made in the prolongation of the branch of the mine, but at one side, and lower than the level of the branch, if the soil be dry; but higher if it be wet.

One cubic foot will contain 75 lbs. of powder; upon which principle the size of the case to contain the powder must be regulated. The auget is generally one inch square, interior dimensions, and the end of it must reach the centre of the chamber; where the *saucisson* must be fastened, to prevent its being easily pulled out.

The branch of the mine to be sprung must be closed in the strongest manner by doors well secured by props, and must be stopped with earth or rubbish to a distance, taken in a straight line, equal to 1½ times the line of least resistance.

In proportioning the length of *saucisson*, in order that any number of mines may be fired at the same instant, a return of a right angle is generally reckoned equal to 4 inches in a right line.

The first step in making a mine, whether for attack or defence, is to sink a shaft to the depth of the bottom of the gallery, having two of its sides in the direction of the sides of the gallery.—These shafts should be where the galleriès are to cross each other, or in the centre of the length of gallery to be made. These shafts should never be further apart than 40 or 50 fathoms; for it is found, that the

the air is not fit for respiration in the larger galleries at a greater distance from the shaft than 25 fathoms; at 20 fathoms in those of medium dimensions; and at 15 in the smallest.

The rectangular frames used in sinking a shaft are commonly placed 4 feet asunder; and in the galleries they are only 3 feet.—A gallery intended to be lined with masonry, must be 7 feet high, and 6 feet wide, in order that it may be, when finished, 6 feet high, and 3 feet wide.

Temporary galleries are only made 4½ feet high, and 2½ or 3 feet wide.

The branches, at the ends of which the chambers are to be placed, are only made 2½ or 3 feet high, and 2 feet, or 3 feet 3 inches wide.

The first of these are dug on the knees; the second sitting or lying.

The miners are divided into brigades of 4 each; and the rate of work for each brigade is 3 feet of the temporary gallery in 4 hours. The first brigade is relieved by a second, after having worked 4 hours, or laid one frame; which second brigade is again relieved by the first, at the expiration of the same time.

In the most easy ground to work, a miner may be heard to the distance of 14 or 15 fathoms under ground; and the noise made by fixing the frames of the galleries may often be heard as far as 20 or 25 fathoms. A drum braced, standing on the ground, with a few peas, or other round

substances

substances on the head, will be very sensibly affected by an approaching miner.

It is of the most essential consequence to place the entrances to the countermines beyond the reach of any surprize from the enemy.

To prevent an enemy gaining possession of the galleries of the countermines, they should be well secured by strong doors, at every 15 fathoms.—These should be musquet proof.

A glacis, properly countermined, and every advantage taken of it to retard the besiegers, may, with proper management, prolong a siege at least 2 months: and if the rest of the works are also countermined, and properly defended, they may add another month to the siege.—Every system of countermines must depend upon the system of fortification to which they are to be adapted; the general principle for their regulation is, that the galleries should occupy situations, from which branches can be most readily run out under the most probable points of the besieger's batteries and approaches.—The general system of countermines, commonly used in a place prepared beforehand, is as follows:—The principal, or *magistral* gallery runs all around the work, under the banquette of the covert-way, and across the places of arms, having the entrances at the re-entering places of arms. Nearly parallel to this, at 20, 25, or 30 fathoms distance, is another gallery called the *envelope*.—These two galleries are connected by galleries

galleries of *communication*, under the gutters of the re-entering parts of the glacis, and under the ridges of the salient parts. From the envelope are run out, about 15 or 16 fathoms, galleries, in directions parallel to the capitals of the works, and at 23 fathoms distance from each other.—These are called *listeners*.

Sometimes shafts are sunk from the ends of these listeners, and by connecting these shafts, a second envelope formed.—Behind the escarpes of the different works, galleries are likewise made, about the level of the bottom of the ditch; from whence branches may be run out into or under the foundations of the walls; and if the ditch be dry, galleries of communication may be made from these to the magistral gallery; and from which communications branches may be run out for chambers to annoy the besiegers in their passage of the ditch.—The entrances to the escarpe galleries are by means of posterns, which descend from behind the interior slope of the rampart.

If a place be not countermined before hand, a great deal may be done, even after the investment of the place, to prolong the siege by countermines.—In this case, the first thing to be done immediately that the place is invested, is to sink a shaft in each of the places of arms of the covert-way; one in each branch of the covert-way, opposite that part of the bastion where the breach will most probably be made; and one in the flanked angle of each bastion. Those on the covert-way will be on the banquette, and sunk to about

about 18 inches below the bottom of the ditch.—Those in the bastions to about 12 feet below the bottom of the ditch.—Thus prepared, the moment the side on which the attack is to be made, can be ascertained, galleries must be carried on from these shafts on the side attacked along the capitals, in the form of trefles, or double T; and advanced as far into the country as the time will admit. Communication galleries may likewise be driven between these different works on the covert-way, and from them to the work in the bastion; which will prevent the enemy gaining possession of their entrances.—All these works may be carried on after the investment of the place; and be in sufficient forwardness by the time the enemy gains the third parallel.

The following rules are given by VAUBAN for fougasses, or small mines, having the diameter of the excavation equal to double the lines of least resistance:—The side of the chamber must be exactly a sixth part of the depth of the shaft.—The side of the box to hold the powder exactly a ninth part of the depth of the shaft.

These remarks respecting mines are principally extracted from the General Essay on Fortification before-mentioned, written in French, and published at Berlin, 1799.

A mine for the destruction of a stone bridge may be made in the following manner. Sink a trench in the form of a cross down to the top of the arch stones. The branches of the cross 10 feet long. Put 160 lbs. of gunpowder into each

each trench. For a thickness of arch of 3 feet, cover the powder over with strong planks, and load them well with rubbish, or ram the earth well above, and fire it either with a hose or portfire secured with clay. A simple trench cut across the crown of the arch 18 inches deep, and loaded with 350lbs. of powder, will answer equally well. 220lbs. of powder in a strong case, suspended under a wooden bridge, will be sufficient to destroy it. A stone bridge, if time will allow, may be more effectually destroyed by mining the piers, as the destruction of one pier causes two arches to fall.

MORTARS.—Weight and Dimensions of English Mortars.

Nature.			Weight.			Length		Powder *contained in Chamber.		Range at 45 Degrees.
			ct.	qrs	lbs.	Ft.	In.	lbs.	oz.	yards.
13	Brass	Sea S..	82	..	8	5	3	32	..	4100
13	Iron	Sea S..	82	1	..			20		
13	Brass	Land ..	25	..	10	3	7½	9	12	2100
13	Iron	Land ..	36	2	12			9	8	
10	Brass	Sea S. .	33	..	..	4	8	12	8	3800
10	Iron	Sea S. .	41	..	..			10		
10	Brass	Land ..	10	1	25	2	9	4	10	1900
10	Iron	Land ..	16	..	6			4	8	
8	Brass	Land..	4	1	8	2	1¾	2	..	1600
8	Iron	Land..	8	..	11			2	4	
5½—Brass—Land			1	..	20	1	4¼	..	9	1200
$4\frac{2}{5}$—Brass—Land			..	3	11	1	1½	..	4½	1000

* See the word *Chambers*, for experiments on the best forms.

Mortars in Current Service, 1827.

Land Service. Brass.		Land Service. Iron.		Sea Service. Iron.	
Nature	Weight.	Nature.	Weight.	Nature.	Weight.
Inches.	cwt qr. lb.	Inches.	ct. qr. lb.	Inches.	ct. qr. lb.
10	12 3 0	13	36 0 0	13	102 1 6
8	6 2 0	10	16 1 0	10	36 2 0
$5\frac{1}{2}$	1 1 0	8	8 1 0		
$4\frac{2}{5}$	.. 3 0				

French Mortars, in their own Weights and Measures.

	lbs.	wt. of sh$^{l.}$			
12 Inches	2060	147lb.	3	7	2400
10 for long Ranges ...	2000	100	7	4	2800
10 — short Ditto	1560	100	4	..	2200
8 ————	595	44	1	$4\frac{1}{4}$	1160
Stone Mortars*	1100	....	2	8	
12 Inch Gomers	2750	147	12	..	2700
10 —— Gomers	2000	100	6	8	2800
8 —— Gomers	600	47	2	..	1400

* Stone mortars should not be fired at a greater distance than 250 yards.

*Austrian Mortars.**

Nature.	Weight.	Do. of Sh^{l}	Charge.	Elevat^{n}	Ext^{reme} Range.
100-Pr.	....	....	8 lbs.	45°	3600
60-Pr.	2056lb.	108lb.	5	45	3300
30-Pr.	1020	54	3	45	2600
10-Pr.	350	19	1	45	1000

* See the word *Shell*, for the classification of German mortars.

General Rules for Mortar Practice.

13-*Inch*,

3 lbs. of powder gives a range of 1100 yards, nearly every ½ lb. increase of charge increases the range by 150 yards, and every ½ lb. decrease diminishes the range by 200 yards.

10-*Inch*.

Half the quantity calculated for the 13-inch mortar gives nearly the same range.

8-*Inch*.

One-third of the quantity calculated for the 13 inch mortar, for the same range.

5⅔-*Inch*.

1oz. 8 drs. gives a range of 150 yards, and every 4 drs. increase of charge increases the range by 50 yards, as far as 600 yards.

At 15° elevation, the first graze is rather more than half the range at 45° with the same charge.

At 10° of elevation the first graze is rather less than half the range at 45° with the same charge.

For the length of fuze—see *Fuzes*.

Rule.

To find the time of flight, the range being given:

Extract the square root of the range in feet, and divide by 4.

To

Rule.

To find the range, the time of flight being given:

Multiply the time of flight by 4, and square the product for the range in feet.

To find the charge of powder, the range being given:

Divide the range of a 13-inch by 20; of a 10-inch by 40; of an 8-inch by 80; and of a 5½ inch by 160, for the charge in ounces.

Rule.

To find the charge of powder to throw a shell out of a 10-inch mortar, or any other, at any number of degrees of elevation, with the range of any number of yards:

As the sine of double the given angle is to the sine of double the proposed angle, so is the range of the first angle to the range of the latter.

Weights to be put into the Scale when weighing Shells for Practice.

Shells.	N° of Weights.	Nature of Weights.	Total. Weight.
13-Inch.	3 1 1	of 56 lbs. — 28 — 4	200
10-Inch.	1 1 1	— 56 — 28 — 8	92
8-Inch.	1 1 1	— 28 — 14 — 4	46
5½-Inch.	1 1	— 14 — 2	16

Ranges

Ranges with a 10-Inch Sea Mortar, at 21 Degrees, on a Horizontal Plane.

Weight of Mortar.	Weight of Shell.	Charge	Eleva-tion.	Flight.	Range.
ct. qrs. lbs.	lbs. oz.	lbs. oz.	Deg.	Sec.	Yards.
34 2 14	86 ..	5 8	21	14¾	2335
	87 ..			16	2510

Ranges with Sea Service Iron Mortars, at 45 Degrees, upon a Horizontal Plane.

13-Inch.			10-Inch.		
Charge.	Flight.	Range.	Charge.	Flight.	Range.
lbs. oz.	Sec.	Yards.	lbs. oz.	Sec.	Yards.
2 ..	13	690	1 ..	13	680
4 ..	18	1400	2 ..	18	1340
6 ..	21	1900	3 ..	21	1900
8 ..	24½	2575	4 ..	24½	2500
10 ..	26½	2975	5 ..	26	2800
12 ..	29	3500	6 ..	27	3200
14 ..	29½	3860	7 ..	29	3500
16 ..	30	3900	8 ..	30	3800
18 ..	80½	4000	9 ..	30½	3900
20 ..	31	4200	9 8	30½	4000

Ranges with French Mortars, of 45 Degrees, in French Weights and Measures.

12-Inch.			10-Inch, long Ranges.			10-Inch, short Ranges.			8-Inch.		
Charge.		Range.	Charge.		Range.	Charge.		Range.	Charge.		Range.
lbs.	oz.	Yards.	lbs.	oz.	Yards.	lbs.	oz.	Yards.	lbs.	oz.	Yards.
1	..	388	1	..	450	1	..	618	..	5	316
1	8	632	2	..	1080	1	8	964	..	10	794
2	..	862	3	..	1536	2	..	1280	..	15	1112
2	8	954	4	..	2070	2	8	1428	1	4	1280
3	..	1292	5	..	2206	3	..	1432			
3	8	1390	6	2½	2304	3	10½	1920			

Medium Ranges with Land Service Iron Mortars, at 45 Degrees.*

13-Inch.				10-Inch.			
Charge.		Flight.	Range.	Charge.		Flight.	Range.
lbs.	oz.	Sec.	Yards.	lbs.	oz.	Sec.	Yards.
..	14	6½	245	..	8	6½	235
1	..	7½	318	..	10	8	358
1	4	8½	412	..	12	9	464
1	8	9½	523	..	14	10	534
1	12	10½	613	1	..	10½	638
2	..	11	697	1	2	11½	749
2	4	12½	840	1	4	13	873
2	8	13	906	1	6	13½	956
2	12	14	1054	1	8	14	1028
3	..	15	1132	1	10	15	1123
3	4	16	1244	1	12	15	1226
3	8	16½	1317	1	14	16	1325
3	12	17	1424	2	..	16½	1357
4	..	17	1490	2	2	17	1480
4	4	17½	1580	2	4	17½	1532
4	8	18½	1656	2	6	17½	1571
4	12	19	1744	2	8	18½	1700
5	..	19½	1824	2	10	19	1780
5	4	19½	1900	2	12	19½	1825
5	8	20	1950	2	14	20	1880
5	12	20½	2062	3	..	20	1916
6	..	21	2095	4	..	25	2485
7	..	24	2510	4	8	26	2536
8	..	25	2706				

* The range may be considerably augmented by fixing the shell in with wooden wedges.—*Scharnhorst's Artillery, Vol.* II.

Medium

Medium Ranges with Land Service Iron Mortars, at 45 *Degrees.*—Continued.

8-Inch.			5½-Inch, Brass.		
Charge.	Flight.	Range.	Charge.	Flight.	Range.
lbs. oz.	Sec.	Yards.	oz. dr.	Sec.	Yards.
.. 5	6	225	1 8	5½	155
.. 6	7½	328	1 2	6	198
.. 7	8½	428	2 ..	6½	255
.. 8	9½	474	2 4	7½	316
.. 9	10	560	2 8	8	380
.. 10	11	664	2 12	8½	426
.. 11	12	762	3 ..	9½	470
.. 12	12½	801	3 4	10	540
.. 13	13½	859	3 8	10½	590
.. 14	14	960	3 12	11	630
.. 15	14½	1011	4 ..	11½	725
1 0	14½	1115	4 4	12	746
1 1	15	1156	4 8	12¾	800
1 2	16	1262	4 12	13½	910
1 3	16½	1320	5 ..	13½	935
1 4	17	1380	5 4	14	1016
1 5	17½	1446	5 8	..	
1 6	18½	1520	5 11	..	
1 7	18½	1600	6 ..	15	1175
1 8	19	1660			
1 9	19½	1720			

Medium

Medium Ranges with Brass Mortars, at 45 Degrees.

13-Inch.*		10-Inch.		8-Inch.	
Charge.	Range.	Charge.	Range.	Charge.	Range.
lbs. oz.	Yards.	lbs. oz.	Yards.	oz. dr.	Yards.
2 12	862	1 10	823	10 8	580
2 14	939	1 11	852	11 ..	635
3 ..	998	1 12	783	11 8	711
3 2	1003	1 13	758	12 ..	703
3 4	1090	1 14	823	12 8	701
3 6	1139	1 15	888	13 ..	777
3 8	1165	2 ..	892	13 8	825
3 10	1209	2 1	940	14 ..	870
3 12	1220	2 2	941	14 8	853
3 14	1322	2 3	1041	15 ..	866
4 ..	1309	2 4	1128	15 8	899
4 2	1331	2 5	1103	16 ..	921
4 4	1391	2 6	1221	16 8	987
4 6	1363	2 7	1258	17 ..	987
4 8	1324	2 8	1215	17 8	1062

* For the ranges with the 5½-inch brass, see the *Iron Mortars.*

Ranges with a 5½-Inch Brass Mortar, at 15 Degrees.

Charge.	Flight.	First Graze.	Rolled to
oz. dr.	Seconds.	Yards.	Yards.
2 8	3	209	303
3 ..	3½	256	330
3 8	4	375	443
4 ..	4½	457	501
4 8	5	530	600
5 ..	5½	561	627
4 8	6½	667	715
6 ..	7	709	780

Medium

Medium Ranges with Land Service Iron Mortars, at 10 Degrees Elevation.—Powder in Cartridges.

10-Inch.				8-Inch.			
Flight.	Charge.	First Graze.	Extreme Range.	Flight.	Charge.	First Graze.	Extreme Range.
Sec.	lbs. oz.	Yards.	Yards.	Sec.	lbs. oz	Yards.	Yards.
3	.. 12	198	415	3	.. 8	202	403
3½	1 ..	278	458	3	.. 10	266	461
4	1 4	366	564	3¼	.. 12	351	614
4½	1 8	451	686	4	.. 14	413	630
4	1 12	432	686	4¾	1 ..	468	754
4¾	2 ..	559	938	5	1 2	562	811
5	2 4	502	798	6	1 4	664	950
4¾	2 8	597	976	6½	1 6	700	1028
5	2 12	664	1121	6½	1 8	768	1064
5½	3 ..	764	1169				

Medium Ranges with the above Mortars, at 15 Degrees.

10-Inch.			8-Inch.		
Charge.	Flight.	Range.	Charge.	Flight.	Range.
lbs. oz.	Sec.	Yards.	lbs oz.	Sec.	Yards.
1 4	5	464	.. 11	4½	427
1 6	5½	543	.. 12	4½	485
1 8	6	590	.. 13	5	513
1 12	6¾	685	.. 14	5½	559
1 14	7	765	1 ..	6½	690
2 ..	7	805	1 2	7	822
2 4	7½	884	1 4	7	827
2 8	7¾	960	1 6	7¾	1004
2 12	8	1070	1 8	8½	1012
3 ..	8½	1154	1 10	8½	1196
			1 11	9	1337

ORD.

ORDNANCE.—The value of all brass ordnance is at £84 17*s.* *per* ton, for the metal; that is the weight of the gun, and 12lb. *per* hundred-weight for waste: to which is added for casting, on the total weight of metal used, £64 *per* ton for light pieces; £54 for medium; and £44 for heavy.

Iron ordnance cost £20 *per* ton.—See also the words *Guns, Mortars, Howitzers,* &c.

For the proof of all kinds of ordnance, see the word *Proof.*

Ordnance, Board of, consists of five principal officers, besides the Master-General, *viz.* a Lieut.-General, Surveyor-General, Clerk of the Ordnance, Storekeeper, and a Clerk of delivery.—The office is in Pall Mall.

PAC

PACE.—The common pace is of no determined length; though made use of as a measure by most military writers.

In Germany, and amongst most of the Northern Powers, the pace is considered equal to two-tenths of a Rhinland foot.

In France, the pace is commonly reckoned at $2\frac{1}{2}$ feet.

In England, it is usually reckoned at $2\frac{1}{2}$ feet.

The geometrical pace is equal to 5 French royal feet; 60,000 of which make a degree of the equator. This makes the geometrical pace equal to 6·102 English feet, and 5·6719 Rhinland feet.

For the military pace, see *Marching*.

*PAY.—Table of the Pay per Diem of the Officers, Non-commissioned Officers, and Privates, of the Marching and Invalid Artillery, and Corps of Royal Engineers.**

Rank.	Artillery. Horse. £.	s.	d.	Artillery. Foot. £.	s.	d.	Invalid. £.	s.	d.	Royal Engineers. £.	s.	d.
Colonel Commandant	2	19	6	2	14	4	2	14	4	2	14	4
Colonel	1	12	..	1	6	..	1	6	..	1	3	9
Lieutenant-Colonel	1	6	9	..	17	11	..	17	11	..	17	11
Major	1	2	8	..	16	9	..	16	9			
Brevet Major and Captain	..	..	..	..	13	..	..	13	..	..	13	
Captain and 2d Captain	..	15	11	..	11	..	..	11	..	..	11	
1st Lieutenant under 7 years	..	9	10	..	6	10	..	6	10	..	6	10
Ditto above 7 years	..	10	10	..	7	10	..	7	10	..	7	10
2d Lieutenant	..	..	..	..	5	7	..	5	7	..	5	7
Adjutant	..	10	6	..	8	6	..	8	6			
Brigade-Major	..	..	..	..	..	..	..	..	..	..	10	
Quarter-Master	..	10	9	..	7	10	..	7	10			
Adjutant and Quarter-Master	..	..	..	..	..	..	..	..	..	..	6	
Staff Serjeant	..	3	9¼	..	3	7¼	..	3	7¼			
Serjeant	..	2	7¼	..	2	5¼	..	2	5¼			
Corporal — Under 7 years	..	2	4	..	2	2	..	2	2			
Corporal — Between 7 & 14 years	..	2	5	..	2	3	..	2	3			
Corporal — Above 14 years	..	2	6	..	2	4	..	2	4			
Bombardier — Under 7 years	..	2	2	..	2	..	..	2				
Bombardier — Between 7 & 14 years	..	2	3	..	2	1	..	2	1			
Bombardier — Above 14 years	..	2	4	..	2	2	..	2	2			

* The Officers of the Royal Engineers receive double pay on foreign service, and half pay in addition to full pay on home service.

PAY.

PAY.—Table of the Pay per Diem of the Officers, Non-commissioned Officers, and Privates, of the Marching and Invalid Artillery, and Corps of Royal Engineers.—Continued.

Rank.		Artillery. Horse. £.	s.	d.	Artillery. Foot. £.	s.	d.	Invalid. £.	s.	d.	Royal Engineers. £.	s.	d.
Gunner	Under 7 years	..	1	$5\frac{1}{4}$	..	1	$3\frac{1}{4}$	..	1	$3\frac{1}{4}$			
	Between 7 and 14 years ...	..	1	$6\frac{1}{4}$	..	1	$4\frac{1}{4}$	..	1	$4\frac{1}{4}$			
	Above 14 years..........	..	1	$7\frac{1}{4}$	..	1	$5\frac{1}{4}$	..	1	$5\frac{1}{4}$			
Farrier and Smith	Under 7 years	..	3	$4\frac{3}{4}$									
	Between 7 and 14 years ...	..	3	$5\frac{3}{4}$									
	Above 14 years..........	..	3	$6\frac{3}{4}$									
Shoeing-smith	Under 7 years	..	2	$3\frac{1}{4}$									
	Between 7 and 14 years ...	..	2	$4\frac{1}{4}$									
	Above 14 years..........	..	2	$5\frac{1}{4}$									
Collar-maker and Wheeler.	Under 7 years	..	2	$\frac{3}{4}$									
	Between 7 and 14 years ...	..	2	$1\frac{3}{4}$									
	Above 14 years..........	..	2	$2\frac{3}{4}$									
Trumpeter..	Under 7 years	..	2	$1\frac{1}{4}$									
	Between 7 and 14 years ...	..	2	$2\frac{1}{4}$									
	Above 14 years..........	..	2	$3\frac{1}{4}$									
Drummer...	Under 7 years	..	..	..	..	1	$3\frac{1}{4}$	..	1	$3\frac{1}{4}$			
	Between 7 and 14 years . .	..	..	..	..	1	$4\frac{1}{4}$	..	1	$4\frac{1}{4}$			
	Above 14 years..........	..	..	..	..	1	$5\frac{1}{4}$	..	1	$5\frac{1}{4}$			
1st Gunner....	Above 14 years..........	..	..	..	..	..	..	..	1	9			

Table of the Pay per Diem of the Non-commissioned Officers and Privates of the Corps of Royal Sappers and Miners.

		£.	s.	d.
Serjeant-Major		..	4	$6\frac{1}{2}$
Quarter Master Serjeant		..	4	$0\frac{1}{2}$
Colour Serjeant		..	3	$0\frac{1}{2}$
Serjeant		..	2	$6\frac{1}{2}$
1st Corporal	Under 7 years	..	2	$2\frac{1}{2}$
	Between 7 and 14 years	..	2	$3\frac{1}{2}$
	Above 14 years	..	2	$4\frac{1}{2}$
2d Corporal	Under 7 years	..	1	$10\frac{3}{4}$
	Between 7 and 14 years	..	1	$11\frac{3}{4}$
	Above 14 years	..	2	$0\frac{3}{4}$
Privates and Drummers	Under 7 years	..	1	$2\frac{1}{2}$
	Between 7 and 14 years	..	1	$3\frac{1}{2}$
	Above 14 years	..	1	$4\frac{1}{2}$

Pay of the Military Medical Department of the Ordnance.

	Per Diem.		
	£.	s.	d.
Inspector-General of Ordnance Hospitals	3	0	0
Surgeon-General and Inspector	2	0	0
Assistant Surg.-General & Deputy Inspector	1	10	0
Surgeon above 20 years	0	18	10
Ditto above 10 years	0	14	1
Ditto under 10 years	0	11	4
Seven Senior Assistant-Surgeons, each	0	8	6
Junior Assistant-Surgeons	0	7	6
Surgeon of Horse-Artillery	0	15	0
Senior Assistant-Surgeon of Horse Artillery	0	9	6
Assistant-Surgeon of ditto ditto	0	8	6
Apothecary	0	12	0

PENDULUM.

PENDULUM.—Pendulums for military purposes are best made with a musquet ball, and a piece of silk, or other small line.—Their length must be measured from the centre of the ball to the end of the loop on which they are to swing.—In a cylinder, or other uniform prism or rod, the centre of oscillation, (from whence they must be measured,) is at the distance of one-third from the bottom, or two-thirds below the centre of motion.

Pendulum's length in latitude of London, to swing.

Seconds	$39\frac{1}{8}$ Inches.
$\frac{1}{2}$ Seconds	9·8
$\frac{1}{4}$ Seconds	2·45

The length of a pendulum for vibrating seconds, varies in different latitudes increasing from the equator to the poles, owing to the spheroidical figure of the earth; Sir I. Newton calculated that the equatorial diameter of the earth is to the polar diameter as 230 to 229, and, therefore, that on different parts of its surface, the weight of the same body is different, according as it is nearer to or farther from the centre of the earth; thus a body will weigh more at the poles than on the equator, nearly in the proportion of the above diameters; and hence the length of a pendulum vibrating any equal portions of time, must increase from the equator to the poles; and the degrees of the meridian must also increase on account of the oblate spheroid. Several measurements have been made in different latitudes, both of the length of the pendulums vibrating seconds and of

of the degrees of the meridian; and they have been found nearly to agree with the above theory of Sir I. Newton. The following are selected as of the highest authority.

Length of Pendulums to vibrate Seconds in different Latitudes.—Universal Cambist, V I.

Names of Places.	Degree of Latitude.	French Lines.	English Inches.	Authority.
Under the Equat.	9° 00′	439·07	38·896	by Bouguer.
Portobello	9 34	439·16	39·003	by Ditto
Geneva	46 12	440·17	39·092	by Mallet.
Paris	48 50	440·47	39·119	by Bouguer.
London	51 32	440·57	39·128	Graham and Whitehurst.
Lapland	66 58	441·17	39·181	by Maupertius.

Lengths of Pendulums swinging the Times of the different Marches in a Minute.

			In.	Hun.
Slow time	75	steps	24	96
Quick time	108	——	12	03
Wheeling time........	120	——	9	80
Double march	150	——	6	26

Length of a Degree of the Meridian in different Latitudes.

Names of Places where and by whom the observation was taken.	Latitude.	Date of Observation.	French Toises.	English Miles.
Peru—by La Condamine	0° 0′ 0″	1740	56753	68·7324
India—by Lambton	12 32 0	1805	56763	68·7445
France—by Delambre and Mechain	46 12 0	1796	57018	69·0539
England—by Col. Mudge	52 2 20	1802	57068	69·1139
Sweden—by Swanbergh	66 20 10	1806	57196	69·2689

Length of Pendulums to vibrate Seconds at every fifth Degree of Latitude.

Degrees of Latitude.	Length of Pendulum.	Degrees of Latitude.	Length of Pendulum.	Degrees of Latitude.	Length of Penduulm.
	Inches.		Inches.		Inches.
0	39·027	35	39·084	65	39·168
5	39·029	40	39·097	70	39·177
10	39·032	45	39·111	75	39·185
15	39·036	50	39·126	80	39·191
20	39·044	55	39·142	85	39·195
25	39·057	60	39·158	90	39·197
30	39·070				

Rule. *To find the Length of a Pendulum to make any Number of Vibrations, and* vice versa.

Call the pendulum, making 60 vibrations, the standard length; then say, as the square of the given number of vibrations is to the square of 60; so is the length of the standard to the length sought.—If the length of the pendulum be given, and the number of vibrations it makes in a minute be required; say, as the given length is to the standard length, so is the square of 60, its vibrations in a minute, to the square of the number required.—The square root of which will be the number of vibrations made in a minute.

PETARDS

PETARDS—are of four different sizes :—First contain 12 lb. 13 oz.—Second, 10 lb. 11 oz.—Third, 1 lb. 10 oz.—Fourth, 1 lb.

Blind fuze composition for Petards	mealed powder	7 lbs.
	wood ashes	3 oz.

Stores for one Petard.

Hooks to hang the petard..	2
Gimblets	2
Brass fuze	1
Wrench to screw the fuze	1
Blue paper portfires	6
Slow match, yards	6
Props or forks	2
Copper funnels	1
Tallow, ounces	8
Cartridges	1

PLATFORM.—The common platforms for gun batteries require the following materials for each :—5 sleepers or joists 6 inches squaree, 14 feet long.—1 hurter, 8 or 10 inches square, 8 feet long.—14 planks, 1 foot wide, 11 feet long, 2¾ inches thick.—20 pickets.

The usual slope of platforms for guns is one inch to every yard.

The platforms for mortar batteries are made with 3 sleepers, 8 inches square, and covered with about 11 timbers

bers of the same thickness.—They are laid perfectly horizontal, about 15 feet asunder, and 12 feet from the epaulment.—This is the distance commonly practised for firing only at 45 degrees elevation; but if the platforms be placed at the undermentioned distances from the epaulment, the mortars may be fired at the angles corresponding.

At 13 feet distance for firing at 30 degrees.
21 feet .... at 20
30 feet .... at 15
40 feet .... at 10

over an epaulment of eight feet high.

See also the word *Battery*.

Platform-traversing.

That adapted for general service in this country, is 16 feet long, traversing on 4 iron trucks. The length of the transoms, or distance between the side pieces must depend upon the nature of ordnance intended to be mounted on it; for a 24-pounder the distance is 2 feet 7 inches. The width of the side-pieces are generally 10 inches, and the depth 11 inches, to which is added a 2 inch board on the upper part for the trucks of the gun carriage to recoil on. The height of the traversing platform is regulated according to the height of the parapet, usually allowing 6 inches from the under part of the gun to the top of the parapet. The slope on which the gun recoils is 1 inch to a foot. The pivot on which the platform traverses, is placed in the front

front centre, or rear transom; in batteries liable to be attacked in the rear, it would be advisable to place the pivot in such a manner, that the gun may be brought round to defend the gorge of the work.

The gun carriage is the same as that for garrison service.

POINT BLANK.—For the point blank ranges of different pieces of ordnance, see the different natures.

The French *point blank* or *but en blank*, is what the English artillery call the *line of metal elevation*; in most guns between one and two degrees.

PONTOONS.—The pontoons used for forming bridges in the British service, are made of tin, of which there are two sizes.

	Large.	Small.
	Ft. In.	Ft. In.
Total length	21 1	16 10
Breadth	4 10	4
Depth	2 3½	2
	cwt.qrs.lbs.	cwt.qrs.lbs.
Weight of the boat	9 1 24	6 3 16
Weight of the carriage	12 3 19	12 .. 4
Weight of appurtenances	14 3 10	8 .. 7

The carriages for the above are on the principle of a light timber tug, and are drawn by 4 or 6 horses.

Equipage

Equipage of one Pontoon.

	Ft.	In.		Ft.	In.		In.	
4 baulks*............	22	8	long,	1	0	wide,	4	thick.
1 gang-board	22	0		1	0		$2\frac{1}{2}$	
9 chesses	11	6		2	4		$1\frac{1}{2}$	

2 oars	4 binding sticks	4 pickets
1 anchor	4 spring lines	1 small pump
1 graplin	4 faulkes	1 windlass
1 setter	1 cable	1 pontoon carriage, complete
4 iron bolts, with keys	1 sheer-line	
2 mounting bars	1 boat-hook	
	1 maul	

Note.—The baulks, although 22 feet 8 inches long, are reduced by joining to 20 feet 9 inches, which must be taken into consideration in estimating the quantity required for a certain length.

Dimensions of Col. Congreve's wooden Pontoons.

	Ft.	In.
Length at top............	26	0
——— at bottom	23	0
Depth.................	2	8
Width	2	3

The common pontoons will support a weight of 4 or 5000 lbs. They are generally placed, in forming a bridge, about their own width asunder.—See *Bridge* and *Exercise*.

In the French service pontoons have been abolished, as unfit to make bridges over rivers where the current is rapid, and boats substituted in their place.

	Large.		Small.	
	Ft.	In.	Ft.	In.
Total length........	37	0....	28	0
Length of the body..	18	0....	15	0
Exterior breadth....	6	8....	4	9
Depth	3	6....	1	8

When the banks of a river are high, rocky, and not easily shelved off, tressels are placed in the middle of each boat, to raise the bridge.

PORTFIRES.—Composition—saltpetre, 60 parts; sulphur, 40 parts; mealed powder, 20 parts—length of each, 16½ inches.

One will burn from 12 to 15 minutes—weight of one dozen, 3 lbs. 12 ozs.

Portfires were made at Gibraltar in the following manner:—two ounces of nitre was dissolved in a gallon of water, and sheets of soft brown paper dipped in the solution: these, when dry, were rolled up to about the size of common portfires.

The cases for portfires are made of cartridge paper, pasted all over one side, and rolled on an iron former, giving four or five turns under the rolling-board. The number to be rolled in one day by two persons is sixteen dozen, including dry rolling. When rolled, one end must be turned in with a pricker, to form a bottom. Portfires are driven in brass moulds, kept together by rings; 15 strokes must be given with

with a mallet upon the drift to each ladle-ful of composition; the ends are afterwards primed with mealed powder and spirits of wine. One portfire makes eight pieces for proving guns.

French Portfires.

	Time 1 will burn.	Composition.		
		Mealed Powder.	Saltpetre.	Sulphur.
	Minutes			
Moistened with lins^d oil	10	10	12	6
Common	7	4	16	8
Quick.	6	8	16	6
Quicker	5	8	16	4
Modern	..	6	16	7

PROVISIONS.—See the word *Ration*.

PROOF—of ordnance.

All natures of ordnance undergo several kinds of proof before they are received into His Majesty's service; viz. 1st. They are guaged as to their several dimensions, internal and external, as to the justness of the position of the bore, the chamber, the vent, the trunnions, &c.

2d. They are fired with a regulated charge of powder and

and shot, and afterwards searched to discover irregularities or holes produced by the firing.

3d. By means of engines, an endeavour is made to force water through them; and,

4th. They are examined internally, by means of light reflected from a mirror.

Iron Guns.—The guns are first examined as to their proper dimensions, in which, in no case more, than three-tenths of an inch variation is allowed, and in the diameter of the bore only one-thirtieth from 42 to 18-pounders, and one-fortieth from 12 to 4-pounders; but in the position of the bore $\frac{1}{2}$ an inch out of the axis of a piece from a 42 to an 18-pounder, and $\frac{1}{3}$ of an inch from a 12 to 4-pounder, is allowed. They are then fired twice with the charge in the following table, with one shot and two high junk wads, and examined with a searcher after each round. In this examination they must not have any hole or cavity in the bore of two-tenths of an inch in depth, behind the first reinforce ring, or $\frac{1}{4}$ of an inch in depth before this ring.

Nature	Proof Charge.		Nature	Proof Charge.		Nature	Proof Charge.	
Prs.	lbs.	ozs.	Prs.	lbs.	ozs.	Prs.	lbs.	ozs.
42	25	..	12	12	..	3	3	
32	21	8	9	9	..	2	2	
24	18	..	6	6	..	$1\frac{1}{2}$	1	8
18	15	..	4	4	..	1	1	

Iron

Iron guns are scaled with one-twelfth the weight of the shot.

Brass Guns.—From 1-pounders to 12-pounders the diameter of the bore must not vary more than one-fortieth of an inch, and in no dimensions more than two-tenths. The following are the established charges for their proof.—The heavy and medium guns with a charge equal to the weight of the shot, except the medium 12-pounder, which is proved with only 9 lbs. The light guns with half the weight of the shot.—The brass ordnance have not, however, been proved of late with such charges, but with the following:

3-prs. light, 3 times, with 1 lb. each round.
6-prs. light, 3 times, with 2 lbs. each.
12-prs. light, 2 times, with 4 lbs. each.
12-prs. med. 2 times, with 5 lbs. each.

Any hole ·15 of an inch deep upwards or sideways in the bore, or ·1 in the bottom, between the breech and first reinforce; or ·2 of an inch upwards or sideways; or ·15 in the bottom of the bore, before the first reinforce ring, will be sufficient to condemn them.

The French prove their brass guns and howitzers when the calibre is bored to 10 points less than the diameter the piece is to receive: and if any imperfections, resulting from the effect of the shot, are perceived, they are rejected; if not, they are bored to the true diameter, and proved again.

Brass Mortars and Howitzers.—The exterior dimensions are

are in no respect to deviate more than one-tenth of an inch in an 8-inch howitzer, and one-twentieth in the royals and Coehorn mortars and howitzers.—Their bores and chambers not to deviate from their true diameters or positions more than one-fortieth of an inch.

The brass mortars and howitzers are fired twice with their chambers full of powder, and an iron shell. The mortars on their own beds, at about 75° elevation; and the howitzers on their carriages, at about 12°.—Iron mortars are proved on their iron beds, with a charge equal to the full chamber, and an iron shot equal in diameter to the shell.

Royals, or Coehorn mortars, having a hole ·1 of an inch in depth in the chamber, or ·15 in the chase, are rejected: royal howitzers the same.—8-inch howitzers having a hole ·15 of an inch in depth in the chamber, or ·2 in the chase, will be rejected.

Carronades.—The diameter and position of their bore and chamber must not deviate one-twentieth of an inch. They are proved with 2 rounds, with their chambers full of powder, and 1 shot and 1 wad. A hole of two-tenths of an inch in depth in the bore, or one-tenth in the chamber, condemns the piece.

Proof

Proof Charges.

68-Prs.	42	32	24	18	12
13 lbs.	9	8	6	4	3

All ordnance, after having undergone this proof, and the subsequent searching, are subject to the water proof. This is done by means of a forcing pump, having a pipe or hose fixed to the mouth of the piece; after two or three efforts to force the water through any honeycombs or flaws which may be in the bore, they are left to dry; and generally the next day examined by the reflected light from a mirror. If the bore contains any small holes or flaws which have not been discovered by the former proofs, they are very readily found by this: the water will continue to weep, or run from the holes, when the solid parts of the bore are perfectly dry. Ordnance, suspected of being bad, are often subject to a more severe proof; that of firing 30 rounds quick, with the service charge and 2 shot; and in doubtful cases, where the purity of the metal is suspected, recourse has been had to chemical trials and analysis. A quantity of clean filings, taken from a part of an iron gun free from rust, are dissolved in the dilute sulphuric acid, and the quantity of gas disengaged during the solution accurately ascertained. The plumbago which remains after solution is also separated by filtration, and carefully weighed. Now it

it is well known, that the purer the iron, the greater the quantity of inflammable gas obtained, and the less the proportion of plumbago which remains after the solution; from these two parts, therefore, a tolerable judgment may be formed of the quality of the metal. When the plumbago exceeds $4\frac{1}{2}$ per cent. the iron will always be found deficient in strength; and there has been no instance of a gun bursting where the plumbago did not exceed 3 per cent.; that is, where 100 grains of the metal did not leave more than 3 grains of plumbago. The colour of the plumbago is also to be attended to: when it is brown or reddish, it is an indication of hard metal, and when in quantities and mixed with coals, there can be no doubt but that the iron is too soft for cannon.

For the proof of *Gunpowder*, see that word.

Proof of Iron Shells.—After the shells are gauged and examined as to their dimensions and weight, they must be well scraped out, and the iron pin at the bottom of the inside must be driven down or broken off. They are then to be hammered all over, to knock off the scales, and discover flaws, and no hole, in the large shells, is allowed, of of more than $\frac{3}{4}$ of an inch deep. An empty fuze is then driven into the fuze hole, and the shell is suspended in a tub of water, in such manner that the shell be covered by the water, but that it does not run into the fuze: in this situation the nose of a pair of bellows is put in at the fuze hole, and several strong puffs given with the bellows; and if

if no bubbles rise in the water, the shell is concluded to be serviceable.

Ordnance condemned as unserviceable for any of the foregoing reasons, are marked as follows:—X D, or X S, or X W. The first signifies that they are found to be faulty in their dimensions, by Desagulier's instrument; the second by the searcher; and the third, by the water-proof.

QUI

QUICK-MATCH.—See *Match*.

QUARTER-SIGHTS.—See *Tangent*.

RAN

RANGES.—The following ranges, from field guns of different nations, are extracted from Müller's *Elements of the Science of War*.—1811:

French Artillery.

Nature.	Elevation.	Charge.	First Graze. Paces.	Extreme Range.
24-Pr.	0°	8·5	600	2400
	1		1050	2500
	2		1500	2600
16-Pr.	0	6	575	3300
	1		1025	2450
	2		1400	2500
12-Pr. Heavy	0	4·5	575	2250
	1		1025	2400
	2		1350	2450
12-Pr. Light	0	4·5	575	2250
	1		1025	2400
	2		1350	2450
8-Pr. Heavy	0	3	525	1800
	1		900	1850
	2		1250	1900
8-Pr. Light	0	3	540	1800
	1		925	1850
	2		1270	1925
4-Pr.	0	1·5	475	1500
	1		757	1550
	2		1100	1600

Austrian

Austrian Artillery.

Nature.	Elevation.	Charge.	First Graze. Paces.	Extreme Range.
24-Pr.	0°	7	600	2300
	1		1000	2400
	2		1300	2500
18-Pr.	0	5	575	2100
	1		975	2200
	2		1350	2300
12-Pr. Heavy	0	3·5	550	2000
	1		925	2150
	2		1300	2250
12-Pr. Light	0	3	500	1800
	1		700	1900
	2		900	1950
6-Pr.	0	1·5	500	1600
	1		700	1700
	2		900	1800
2-Pr.	P.B.	0·75	500	1400
	1st. Mark		700	1500
	2d. Mark		900	1600

Danish Artillery.

Nature.	Elevation.	Charge.	First Graze. Paces.	Extreme Range.
24-Pr.	0°	⅓ the weight of the shot.	500	2200
	1		950	2400
	2		1300	2600
18-Pr.	0		500	2200
	1		950	2400
	2		1270	2550

12-Pounder

Nature	Elevation.	Charge.	First Graze, Paces.	Extreme Range.
12-Pr. Heavy	0°		475	2050
	1		850	2250
	2		1250	2400
12-Pr. Light	0		450	2000
	1		830	2200
	2		1230	2400
6-Pr.	0		430	1900
	1		800	2100
	2		1200	2400
3-Pr.	0		420	1800
	1		700	1950
	2		1010	2100

Saxon Artillery.

Nature.	Elevation.	Charge.	First Graze. Paces.	Extreme Range.
12-Pr. Heavy	0°	5	400	1900
	1		850	2000
	2		1300	2200
12-Pr. Light	0	4	300	1900
	1		800	2050
	2		1200	2200
8-Pr. Heavy	0	3·25	300	1800
	1		700	1900
	2		1150	2000
4-Pr.	0	1·75	250	1500
	1		500	1600
	2		1000	1700

Prussian

Prussian Artillery.

Nature.	Elevation.	Charge.	First Graze. Paces.	Extreme Range
24-Pr.	0°	10	550	2300
	1		950	2550
12-Pr. Medium	0	4	500	1800
	1		900	1900
	2		1250	2000
6-Pr.	0	3	450	1600
	1		820	1700
	2		1250	1800
3-Pr.	0	1·25	400	1400
	1		600	1500
	2		900	1600

Russian Artillery.

Nature.	Elevation.	Charge.	First Graze. Paces.	Extreme Range.
12-Pr.	0°	4	480	1900
	1		800	2000
	2		1200	2100
6-Pr.	0	2	430	1700
	1		800	1800
	2		1100	1900
3-Pr.	0	1·25	400	1500
	1		650	1700
	2		1000	1900

Spanish

Spanish Artillery.

Nature.	Elevation.	Charge.	First Graze. Paces.	Extreme. Range.
24-Pr.	0°	⅓ of the shot's wt.	600	2300
	1		1000	2400
	2		1350	2500
12-Pr.	0		550	2030
	1		950	2100
	2		1300	2200
8-Pr.	0		500	1700
	1		850	1800
	2		1150	1900
4 Pr.	0		450	1500
	1		750	1600
	2		1050	1700

Ranges of the Howitzers of different Nations.

French.

Nature.	Elevation.	Charge.	First Graze. Paces.	Extreme Range.
6-Inch	1°	0·06 of the shell's weight.	200	1200
	6		950	1700
	10		1500	1750
	30		1800	1870
3-Inch	1°	0·06 of the shell's weight.	230	1960
	5		1000	1960
	10		1700	2090
	30		2100	2100

Austrian

Austrian.

Nature.	Elevation.	Charge.	First Graze. Paces.	Extreme Range.
7-Pr.	1°	12 oz.	125	1100
	5		700	1100
	10		1100	1400
	30		1600	1600
10-Pr.	1	18 oz.	180	1200
	5		1200	1260
	10		1500	1500
	30		1800	1800

Saxon.

Nature.	Elevation.	Charge.	First Graze. Paces.	Extreme Range.
7 P. Gren. P.	1°	1·75 P.	200	1300
	5		1200	1500
	10		1600	1700
8 P. Howitzer	1	1·5 P	200	1200
	5		700	1500
	10		1200	1700
	30		2100	2100

Prussian.

Nature.	Elevation.	Charge.	First Graze. Paces.	Extreme Range.
7-Pr.	1°	1·25	250	1200
	5		900	1400
	10		1530	1600
	30		1900	1900

10-Pounder

Nature.	Elevation.	Charge.	First Graze. Paces.	Extreme Range.
10-Pr.	1°	1·75	175	1300
	5		1000	1500
	10		1600	1750
	30		2000	2000
	1	2·25	200	1500
	5		1100	1600
	10		1700	1800
	30		2200	2200

Danish.

Nature.	Elevation.	Charge.	First Graze. Paces.	Extreme Range.
10-Pr.	5°	1 P.	900	1300
	10		1400	1500
	30		1700	1700
18-Pr.	5	2 P.	1000	1500
	10		1500	1700
	30		1800	1800

RANK.—Between Land and Sea Officers.

Navy.	*Army.*
1. Admiral, or Commander of his Majesty's fleet	Field Marshal.
2. Admirals with their flags at the main-top-mast head	Generals.
3. Vice-Admirals	Lieutenant-Generals.
4. Rear-Admirals	Major-Generals.
5. Commodores, with broad pendants	Brigadiers.
6. Captains commanding post ships, after 3 years	Colonels.
7. All Captains commanding post ships	Lieutenant-Colonels.
8. Captains not taking post	Majors.
9. Lieutenant	Captains.

The rank and precedence of sea-officers in the classes above-mentioned are to take place according to the seniority of their respective commissions in the sea-service. Post-captains commanding ships or vessels that do not give post, rank only as majors during the time they command those vessels.

Nothing of this shall give any pretence to land officers to command any of his Majesty's squadrons; nor to any sea-officer to command on shore; nor shall either have right to demand the military honours due to their respective ranks, unless upon actual service.

RATION.—For an officer or soldier.

Complete Ration of the small Species.

Flour, or bread	$1\frac{1}{2}$ lb.
Beef	1
Or Pork	$\frac{1}{2}$
Peas	$\frac{1}{4}$ pint.
Butter, or cheese	1 oz.
Rice	1 oz.

When the small species are not issued, $1\frac{1}{2}$ lb. of flour or bread, with $1\frac{1}{2}$ lbs. of beef, or 10 oz. of pork, forms a complete ration; or 3 lbs. of beef, or 2 lbs. of cheese, or half a pound of rice, forms a complete ration.

At sea the ration is different. The following table contains the allowances for six soldiers, or four seamen, on

board of ship, for each day in the week. Women are provisioned at $\frac{1}{2}$ and children at $\frac{1}{4}$ of a soldier's allowance, but receive no rum.

Days of the Week	Bread.	Beer, Gallons, or $\frac{1}{2}$ Pints of Spirits or Pints of Wine.	Beef, Pieces of 8 lbs.	Pork, Pieces of 4 lbs.	Pints of Peas.	Do. Oatmeal.	lbs. of Butter.	lbs. of Cheese.	Vinegar.
	lbs.								
Sunday .	4	.. 4 ..	..	1	2				One Quart a Week.
Monday .	4	.. 4 ..	..	..	..	4	$\frac{1}{2}$	1	
Tuesday .	4	.. 4 ..	1						
Wednes.	4	.. 4 ..	or 6 lbs. of flour, or $\frac{1}{2}$ lb. of suet, and 1 lb. of raisins	..	2	4	$\frac{1}{2}$	1	
Thursday	4	.. 4 ..		1	2				
Friday . .	4	.. 4 ..		..	2	4	$\frac{1}{2}$	1	
Saturday	4	.. 4 ..	1 or as above.						

The above are served out by full weights and measures.

When flour, suet, and raisins, are put on board, they are to be served out in equal proportions with beef, viz. half in beef; the other half in flour, suet, and raisins, on each beef day.

4 lbs. of flour, or 3 lbs. of flour with $\frac{1}{2}$ lb. of raisins, (or $\frac{1}{4}$ lb. of currents) and $\frac{1}{4}$ lb. of suet, are equal to 4 lbs. of beef, or 2 lbs. of pork with peas, but are not to be issued in lieu of the latter, except unavoidable, and then the quantities must be certified.

$\frac{1}{2}$ lb. of rice is equal to a pint of oatmeal; $\frac{1}{2}$ lb. of sugar is equal to $\frac{1}{2}$ lb. of butter; and 1 lb. of rice is equal to 1 lb. of

of cheese; 1 pint of oil is equal to 1 lb. of butter, or 2 lb. of cheese, that is, a pint of oil for the proportion of butter and cheese.

A pint of wine, or ½ pint of brandy, rum, or arrack, is equal to a gallon of beer; 1 lb. of fresh beef is equal to 1 lb. of salt beef; and 1½ lbs. of fresh beef is equal to 1 lb. of pork.

No wine or spirits are to be issued to the troops while in port, nor at sea, till after all the beer is expended.

The masters of transports are to produce a certificate from the commanding officer of the troops on board, of the quantity expended. If any doubt be entertained of the provisions being full weight, a cask must be weighed in the presence of the commanding officer, the master, and the mate: and the master may, upon the certificate of the commanding officer, and the oath of the mate, issue as much beef and pork as will make up the deficiency.

The weight of each must be as follows:—14 pieces of beef, cut for 8 pound pieces taken out of the cask as they rise, and the salt shaken off, are to weigh 112 lbs. avoirdupois; 28 pieces of pork, cut for 4 lb. pieces, are also to weigh, under like circumstances, 112 lbs.

The deductions to be taken for provisions from the pay of officers, non-commissioned officers, or men, are the same for all ranks, and in all corps, under the like circumstances of service, when serving out of Great Britain, on stations where provisions are supplied by the public: also, when embarked

embarked in transports or other vessels, (except when serving as marines;) also when prisoners of war, and maintained at the expense of Great Britain; also when in general hospitals, whether at home or abroad, a deduction of *six-pence per day.*

A deduction of *three-pence halfpenny* from the pay of every non-commissioned officer and private in Jamaica, in New South Wales, or Gibraltar. Non-commissioned officers and soldiers serving as marines shall not be liable to any deduction from their full pay on account of provisions.

Ration for a horse on home service in 1796:—14 lbs. of hay, 10 lbs. of oats, 4 lbs of straw; for which a stoppage is made of *six-pence,—Army Regulations,* 1799.

RECOIL.

Of Field Guns on Travelling Carriages, upon Elm Planks.

Nature.	Charge.		1 Shot at 1° 30′ Elevation	2 Shot at 1° 30′ Elevation	Case Shot at 3° 45′ Elevation
	lbs.	oz.	Feet.	Feet.	Feet.
12-Pr. Med.	4	..	12	25	8½
6-Pr. Heavy	2	..	7	11	7½
6-Pr. Light	1	8	12	21	10
3-Pr. Heavy	1	..	7	5	3½

Recoils

Recoils of Iron Ordnance on Platforms, having a slope of 1 inch to a yard.—Sutton Heath, 1810.

Elevation.	Garrison Carriage.										Iron Carriage.					
	24-Pr. of $9\frac{1}{2}$ Ft.						24-Pr. of $6\frac{1}{2}$ Feet.				18-Pr. of $9\frac{1}{2}$ Feet.					
	8 lbs.		6 lbs.		4 lbs.		6 lbs.		4 lbs.		6 lbs.		4 lb. 8 oz.		3 lbs.	
	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.
P.B.	4	3	3	3	1	11	5	10	3	3	6	..	4	..	2	4
1	4	..	3	..	2	..	5	5	3	3	5	10	3	7	2	3
2	3	8	2	10	1	11	5	3	3	2	5	7	3	11	3	5
3	4	6	3	4	2	..	5	4	2	9	5	8	3	8	3	2
4	3	9	3	..	1	9	5	4	2	10	5	2	3	6	2	2
5	3	8	2	8	1	7	5	..	2	11	5	3	3	..	1	8
6	3	7	2	7	1	7	4	9	2	10	4	10	3	8	2	11
7	3	3	2	9	1	8	4	10	2	9	4	5	3	4	1	0
8	4	1	2	10	1	10	4	8	2	10	4	1	2	11	1	7
9	3	7	2	6	1	6	4	6	2	8	4	1	3	2	1	7
10	3	10	2	11	2	3	4	10	3	6	4	8	3	5	1	10
15	3	8	2	8	....		4	3	3	4	4	6	3	4	4	6

Recoil of Sea Service Iron Guns, on Ship Carriages, upon a Horizontal Platform.

Charges of Powder and Shot.	Elevation	32-Pr.		24-Pr.		18-Pr.	
	Degrees.	Ft.	In.	Ft.	In.	Ft.	In.
$\frac{1}{3}$ of Powder and 1 Shot.	2	11	..	11	..	10	6
$\frac{1}{3}$ of Powder and 2 Shot.	4	19	6	18	6	18	
$\frac{1}{4}$ of Powder and 2 Shot.	7	11	6	12	..	12	

Recoil

Recoil of Land Service Iron Mortars, on Iron Beds.

	Ft.	In.
13-Inch, with a charge of 6lbs.	4	2½
10-Inch, ——————— 3lbs.	2	10
8-Inch, ——————— 1lb. 9oz.	3	10

RECONNOITERING.—The following necessary observations to be made in examining a country in a military point of view, are principally translated from the *Aide Memoire*, but improved by some judicious remarks from Mr. Landman's introduction to reconnoitering.

Before an officer sets out to reconnoitre a country, he should trace out from the best map he can procure, its principal features, which will serve him as a guide in his progress through the principal parts which are to be the subject of his observations, and enable him to connect the whole into one grand plan.

His observations should be expressed by written remarks, and by sketches. For this purpose he must be provided with a sketch-book, on the right-hand page of which he may express the appearance of the country by sketches; and on the left, the remarks made on particular parts, with the names of the towns, their distances asunder, &c. with proper references to the sketches.—The scale most proper for this purpose is two inches to a mile; if, therefore, the sketch-book be made six inches wide, and the leaves divided by lines into three equal parts, each division will be one mile, which will be a sufficient scale for the purpose.

1st. *Roads.*—The principal points to be attended to in examining roads for military purposes, are, their direction; the villages, countries, and rivers, which they pass through; the roads which cross them; their names, and the seasons in which they are in best condition: and if ever impassable: their breadth, whether variable or constant: their bottoms, of what principally formed: their ascents and descents, whether practicable for all kinds of carriages. The enclosures may be hedges, ditches, walls, or fences. If the roads require repair for the transport of artillery, and other heavy carriages, observe if the necessary materials are at hand. If they pass over rivers, remark whether by bridges or fords; if through marshes, whether by causeways or otherwise. If two or more roads pursuing the same route, and by which different columns may march, at any part join or cross each other, it will be necessary to observe, whether the march of the columns will be thereby impeded. If they only cross each other, it will be sometimes possible, in hollow ways, to throw a temporary bridge across the deepest, by which one column may pass over and the other under the bridge, without interrupting each other's march.

2. *Fords.*—A ford for cavalry ought not to be deeper than 4 feet; for infantry not more than 3 feet. Observe the banks of the ford at each side; their form, steepness, and height; their situation, as to the turnings of the river. Their bottoms, whether passable for carriages. Observe marks by which the ford may be readily found; points from

from which it may be protected.—Notice the rapidity of the water; whether its height be variable; its direction, its breadth, and the means by which the ford may be destroyed or rendered impassable.

3. *Inundations.*—Learn the manner of working the sluices; the time in which the inundation may be effected; its extent and depth. Observe how the dam may be protected its height and solidity: whether it can be easily raised, or easily destroyed; whether t is commanded by distant positions, and whether the inundation can be otherwise drained. Notice the adjacent country.

4. *Springs and Wells.*—Attend to the quality and quantity of the water; whether it will serve for the cavalry, as well as the infantry, and the manner of its being drawn. Observe the situation of the spring, and of its source, whether it can be protected, and the enemy prevented from cutting it off.

5. *Lakes, Marshes, and Swamps.*—Learn their cause; if arising from a moist soil, the overflowings of rivers, or from springs. Observe their situation, and the appearance of the surrounding country; the best means of crossing them. If they are divided by causeways, notice their breadth and condition:. if not, remark if causeways can be easily established, and whether the swamp can be drained, and whether it is passable at any season of the year. Observe the points from which the causeways can be defended against the passage of an enemy's column. Learn whether or not the

the swamps are subject to fogs; and at what seasons they are most hurtful.

6. *Of Woods and Forests.*—Remark their extent; their situation; their thickness; whether the trees are lofty or low; whether there is much underwood.

Observe if the different clumps form openings or passes; and their extent; whether their sides are formed of thick wood, or brush; whether their breadth is uniform, or widens at particular parts. Remark whether the ground of the forest be level or hilly, swampy or dry. Observe the nature and condition of the roads (for remarks to be made on these, see the article *Roads*); observe also the means the forest affords of intrenching; of making fascines, abbatis, &c. Attend to the face of the country round the forest, whether cultivated fields or meadows: whether it affords positions; is intersected by rivulets, swamps, or ravines.

Remark the castles, villages, towns, &c. in the neighbourhood; and their distance from the skirts of the wood.

Go round the wood and examine its principal débouchés; observe the ravines, rivulets, roads, &c. issuing from it, and learn their direction.

7. *Heaths.*—Notice for what nature of troops they are best calculated. The nature of hedges and brush-wood; some form a good breast-work. Observe the directions of the rivulets, roads, and ravines. When the ground of a heath is of the common colour, the roads are usually good: but

but when it is blackish and mixed with white sand, the roads are generally impassable in winter seasons.

8. *Canals.*—For this article see also the observations on *Rivers.* Observe their intention; the nature of the soil in which they are dug, their breadth and depth; their locks; the craft found upon them; the best means of protecting or destoying them. Learn the countries they pass through.

9. *Rivers.*—Learn in what country they arise, and where empty themselves; the nature of the countries they run through, and whether they belong to us or the enemy.

Learn the extent to which they are navigable; and if they ever freeze over, whether strong enough to bear troops and carriages. Notice the quality of the water, its course, currents, depths, and breadths. The banks and the beds of the rivers.—Observe the nature and number of the craft that navigate them; and the mills upon their banks, whether of wind or water. Visit the bridges and fords; and make the proper remarks on their nature and situation. Learn whether the rivers ever overflow their banks, and at what season, and whether or not this causes inundations.

Observe the most favourable points for crossing, and the roads leading to these points; the turnings and windings of the rivers, the form of their peninsulas, and the most favourable situations for throwing over bridges. If there are any wharfs on the banks, observe what craft can lay alongside of them.

If there are islands in the rivers, note their size; their banks;

banks; whether inhabited, cultivated, woody, or barren; and whether they command the channel.

Observe the mountains and high grounds near the rivers; remark their distance from the banks, and the advantages, or disadvantages which they offer. Learn what branches or conflueuce of other rivers there are either above or below the best situations for crossing. Examine the positions which the adjoining country affords an army to protect the passage of the river; and whether in a perpendicular or parallel direction; and the routes by which 3 or 4 columns may arrive at the place.

10. *Passes.*—Observe their breadth, their length, their situation; the nature of the adjacent country; the best positions to occupy to cover a retreat, or to dispute the pass. How the troops would be best arranged; and the number that would be required for this purpose.

11. *Ravines, Vallies.*—Observe the nature of the soil; whether rocky, or of loose flints. If the sides are rugged and steep, whether they can be easily scraped off. The points that command them; whether storms or floods are to be apprehended; and at what seasons most expected.

12. *Cultivated Lands.*—Notice their state of cultivation; their productions; their time of harvest. Learn what quantity of wheat, rye, barley, oats, or other grain they produce, over and above the necessary subsistence of the inhabitants. How much hay they yield per acre.

13. *Orchards.*—Observe whether they are thick planted,

and

and afford a good cover: their enclosures, whether hedge, ditches, walls, &c.

14. *Bridges.*—Remark their situation; their length and breadth; the materials of which they are built; their strength, whether sufficient to bear artillery: the roads leading to them: their situation, as to the turnings of the river: their purpose; if to connect towns or villages; the nature, direction, and breadth of the streets leading to them. Observe the country around, whether flat or commanding: study the best means of fortifying the bridge head; and observe the best and most expeditious mode by which the bridge may be destroyed, if necessary.

15. *Mountains, Hills.*—Amongst high mountains, such as the Alps, roads are very rare; it is seldom more than the vallies that are inhabited and accessible for troops: observe their slopes, if steep or rugged. Examine the positions; means of gaining the summits; and note the state of cultivation and general appearance of the vallies; the pasturage, forage, cottages, villages, castles, roads, paths, and passes. Distinguish the principal chains of hills and their direction; their relative heights; whether they are sufficienly extensive to form a line of defence; their communications; their strong points: positions proper for batteries, &c.; whether practicable for cavalry and artillery.

16. *Coasts.*—Their nature; whether bordered by downs; surrounded by rocks, which render their approach dangerous; or by shoals, which make their access impracticable

—note

—note the points and headlands proper for forts and batteries to defend the anchorage, ports, harbours, or other accessible parts.—If there are any adjacent isles, perhaps they will serve for the erection of advanced batteries, to form a barrier to the efforts of an enemy.—Observe the nature of the shores, bays, roads for shipping, &c. with the winds required to go in and out the harbours; and whether they are of easy access; their advantages and disadvantages, their size, and depth of water.—If a river empties itself on the coast, observe the particular channel for shipping, and whether it can be defended by any of the batteries.—If the coast is already fortified, observe all the batteries, forts, or intrenchments, established for its defence, and the protection of the anchorage, &c.—Examine the camps and other military posts, which cover the principal points, and the interior of the country.—Estimate all the dangers to be run, and all the obstacles to be overcome in a descent, and point out the means of augmenting them.—Observe the time of tide most favourable for approaching the coast.—Ascertain the number of artillery and other troops constantly on the coast, and the force that can be collected at a short notice; and how soon they can be drawn to any particular point attacked.—Examine the system of defence adopted, and endeavour to improve it.

17. *Forts—Redoubts.*—Remark their form, whether ancient or modern; whether they are permanent or temporary elevated or low; revetted or demi-revetted, with

stone, brick, or turf.—Whether the ditch is wet or dry, fraized or palissaded, natural or artificial. Observe their situation; the face of the adjacent country; whether they effectually command the passes, or protect the country intended.—The defence they are capable of making in their present state, and the improvements of which they are susceptible.

18. *Castles—Citadels.*—Their situations; their form; their extent; their object; the protection they give the city; their connexion and communication with it.—The present state of their defence, and improvements of which they are susceptible.—Their *souterraines.*

19. *Villages.*—Observe their situation; ascertain the number of families they contain; the nature of the land; the quality and quantity of their crops; their markets; the suburbs that supply these markets; their beasts of burthen; their flocks, herds, and poultry, &c.—The number of their ovens; quality of the water; style of the houses, barns, stables, and sheep-walks.—The situation of the church; the nature of the church-yard, and its inclosures.—The wind and water-mills.—Observe whether the village is surrounded by hedges, ditches, banks, or walls; whether it can be easily intrenched.—Its streets; roads leading to it; and the face of the surrounding country.

20. *Cities not fortified.*—Their situation; population; commerce; commodities; manufactures—the succours that may be drawn from them, as to men, horses, &c.—Their

squares

squares and principal buildings.—The defence they are susceptible of; whether they are surrounded by walls, old towers, ditches, &c.—Their gates, and the roads leading to them.—The face of the surrounding country.

21. *Fortified Towns.*—Their situation with respect to their position, and with respect to other towns in the neighbourhood, whether in the first or second line; the assistance which they can afford each other.—The succours that may be drawn from them, or that may be thrown into them in case of a siege.—The direction which such relief, whether of men or provisions, ought to take, according to the side attacked; whether they will serve as depôts or hospitals.—The state of the fortifications, (see the word *Fortification* in the alphabet): their nature; the strength to each front.—The rivers in the neighbourhood; the surrounding country within the range of the guns.—The form of investment; what lines will be required, considering the nature of the country and the positions; and the means the country affords of executing them.—The advantages which the ground would afford between the glacis and the lines, either to the besiegers or besieged; the means of establishing the most certain communications between the different quarters of the army, and the means of cutting them off.

22. *Positions.*—Every military position ought to possess decided advantages of situation, and ought to be commanded in no part of its front, flank, or rear.—All commanding grounds ought to be without the range of cannon. There

—There are four principal objects to be attended to in the choice of a position: 1st. The advantages of the ground; 2d. The supplies for the army; 3d. The objects to be attained; and, 4th. The communications with the rear.—The front of a position should be intersected by rivers, ravines, or broken ground, or any other obstacles which can prevent the enemy advancing in order of battle, and oblige him to pass through defiles; but a position becomes useless when the front is so covered by obstacles, that the army cannot advance or move out of its camp when necessary; but no obstacles can be too great on the flanks.—All obstacles which cover a position, or passes which lead to it, must be within the range of the artillery, or the enemy will pass them unmolested.—In a flat country, where the ground does not afford commanding situations, a position is only more or less eligible, as being covered or protected by obstacles; these are very thick woods, in which there are very few roads; large rivulets which cannot be forded or passed without bridges; narrow roads; deep and broken ravines; ground much intersected with hedges, ditches; &c.; but it is essential that all these obstacles should be under the fire of the artillery.—It is always dangerous to occupy a position, which has its rear so covered by swamps, crossed by rivers or ravines, &c. as to render the retreat of the army difficult.—The number of passes by which an army can retire must be examined and secured, and should never be less than 5 or 6.—The rivers, brooks, &c. in front

of

of a position should never be depended upon for a supply of water, as the enemy may cut them off.—The ground for a camp should not be too much intersected by hedges, ditches, or ravines, which occasion great intervals in the line, and obstruct the communications through the camp.

In an offensive position it is absolutely necessary that the army should not be too much confined by obstacles, but be at liberty to act in every direction; but in a defensive position, the fewer accessible points there are the better: and if the natural difficulties in front and flank are not sufficient to render an enemy's attack dangerous, they must be increased by redoubts, intrenchments, abbatis, inundations, &c.—The obstacles on the flanks should also be of such extent that they cannot be easily turned, without the enemy makes a very great circuit; and consequently exposes his own flank, and weakens his line of communication.—In case the enemy detaches a body to attack a defensive position in the rear, the front must be sufficiently strong to enable the general to oppose the enemy's detachment, by a strong body from his own army. In short, the enemy must not be able by any manœuvre to force the army to quit its position.—The want of wood or water, or other supplies absolutely necessary for an army, renders every other advantage of a position useless; nor can a position be long tenable, that is far removed from its depôts; and has not its intermediate posts perfectly secure

secure from the attacks of an enemy.—For further remarks upon positions, see the word *Artillery in the Field.*

RICOCHET.—Firing is not confined to any particular charge or elevation; each must vary according to the distance and difference of level of the object to be fired at; and particularly of the spot on which it is intended the shot shall make the first bouud.—The smaller the angle is under which a shot is made to ricochet, the longer it will preserve its force and have effect, as it will sink so much less in the ground on which it bounds; and its tenacity will of course present so much less resistance to the shot's progress.—In the ricochet of a fortification of any kind, the angle of elevation should seldom be more than 10°, to throw the shot over a parapet a little higher than the level of the battery.—If the works should be of an extraordinary height, the piece must be removed to such a situation, and have such charge, that it can attain its object at this elevation, or at least under that of 13° or 14°, otherwise the shot will not ricochet, and the carriages will suffer very much.—The first gun in a ricochet battery should be so placed as to sweep the whole length of the rampart of the enemy's work, at 3 or 4 feet from the parapet, and the rest should form as small an angle with the parapet as possible.—For this purpose the guns should be pointed about 4 fathoms from the face of the works towards the

interior.

interior. In the ricochet of ordnance in the field, the objects to be fired at being principally infantry and cavalry, the guns should seldom be elevated above 3 degrees; as with greater angles the ball would be apt to bound too high, and defeat the object intended.—For ricochet practice, see the different pieces of ordnance, as *Gun*, *Mortar*, and *Howitzer*.

DURTUBIE.

See also the words *Platforms* and *Battery*.

Table

Tables of Ricochet Practice, shewing the Charge, Elevation, Time of Flight, and Effect, at different Ranges, with Guns and Howitzers, collected from a Series of Ricochet Firing carried on at Woolwich, between the 14th June and the 2d October, 1821.

TABLE, No. 1.

With Round Shot.

Nature of Ordnance.	Range.	Charge.		Proportion of Charge to the Shot.	Elevation by Quadrant.	No. of Rounds fired.	No. Shot took effect.	Grazes made along Face.	Of Rounds fired proportion took effect.	No. of times traverses were struck.	Remarks.
	Yds.	lb.	oz.		Deg.						
24-Pounder Iron, 9 feet.	400	..	8	48	11	15	10	13	$\frac{2}{3}$	..	Work without traverses.
	..	..	10	$38\frac{1}{2}$	$7\frac{3}{4}$	15	9	10	$\frac{2}{3}$ nearly	..	
	..	..	12	32	$6\frac{1}{4}$	30	18	26	$\frac{2}{3}$ ditto	..	
	600	..	12	32	$9\frac{1}{2}$	30	15	19	$\frac{1}{2}$	..	
	..	1	..	24	$6\frac{1}{2}$	30	17	19	$\frac{1}{2}$ nearly	..	
	..	1	4	$19\frac{1}{5}$	$4\frac{3}{4}$	10	6	7	$\frac{1}{2}$ ditto	..	
	800	1	..	24	$8\frac{1}{2}$	30	10	11	$\frac{1}{3}$	..	
	..	1	4	$19\frac{1}{5}$	$6\frac{1}{2}$	30	10	10	$\frac{1}{3}$	..	
	..	1	8	16	$5\frac{1}{2}$	15	9	11	$\frac{2}{3}$ nearly	..	
	..	2	..	12	$3\frac{3}{4}$	15	6	8	$\frac{2}{5}$	..	
	600	..	12	32	$9\frac{1}{2}$	20	7	5	..	3	Work traversed.
	..	1	..	24	$6\frac{1}{2}$	30	11	7	..	6	
18-Pr. Iron, 8 ft.	400	..	9	32	$6\frac{1}{2}$	30	23	27	$\frac{2}{3}$ nearly	..	Work without traverses
	600	..	12	24	$7\frac{1}{4}$	30	8	11	$\frac{1}{4}$ ditto	..	
	..	1	..	18	5	30	10	13	$\frac{1}{3}$	..	
	800	1	..	18	7	30	10	10	$\frac{1}{3}$	..	
	..	1	8	12	$4\frac{1}{4}$	30	12	13	$\frac{1}{3}$ nearly	..	
	600	..	12	24	$7\frac{1}{4}$	30	9	8	..	5	Work traversed.
	..	1	..	18	5	30	13	9	..	9	

TABLE, No. 2.

With Round Shot.

Nature of Ordnance.	Range.	Charge.		Proportion of Charge to the Shot.	Elevatn by Quadrant.	No. of Rounds fired.	No. Shot took effect.	Grazes made along the Face.	Of Rounds fired, proportn that took effect.	No. of times traverses were struck.	Remarks.
	Yds	lbs.	oz.		deg						
12-Pr. Iron $8\frac{1}{2}$ feet.	400	..	6	32	$6\frac{1}{2}$	30	16	19	$\frac{1}{2}$ near.	..	Work without traverses.
	..	..	8	24	$4\frac{1}{2}$	30	20	21	$\frac{2}{3}$	..	
	600	..	8	24	$7\frac{3}{4}$	30	11	12	$\frac{1}{3}$ near.	..	
	..	..	10	$19\frac{1}{5}$	6	30	12	15	$\frac{1}{3}$ do.	..	
	..	..	12	16	$4\frac{3}{4}$	5	2	2	$\frac{2}{5}$	..	
	800	..	12	16	$6\frac{1}{2}$	30	7	10	$\frac{1}{4}$ near.	..	
	..	1	..	12	$4\frac{1}{2}$	30	15	16	$\frac{1}{2}$	..	
	600	..	8	24	$7\frac{3}{4}$	15	7	3	..	6	Work travd.
	..	..	10	$19\frac{1}{5}$	6	15	6	2	..	5	
9-Pr. Fld Serv. br.	600	..	5	$28\frac{4}{5}$	$9\frac{1}{2}$	10	..	2	..	..	Work without travrses
	..	..	6	24	$7\frac{1}{2}$	10	1	1	..	..	
	..	..	7	$20\frac{4}{7}$	$6\frac{1}{2}$	10	3	3	..	..	
68-Pr. Carron.	600	2	..	34	$6\frac{1}{4}$	10	4	5	..	..	Work without traverses.
24-pr. howit brass.	..	..	12	32	$6\frac{1}{2}$	25	15	16	..	..	
	..	1	..	24	$4\frac{3}{4}$	10	2	2	..	..	
12Pr ditto	..	..	10	$19\frac{1}{5}$	$5\frac{3}{4}$	10	3	3	..	..	

TABLE, No. 3.

With Common Shells.

Nature of Ordnance.	Range.	Charge.		Proportion of Charge to Shell.	Elevation by Quadrant.	Time of Flight.	No. of Rounds fired.	No. Shells took effect.	Grazes made along face	Of rounds fired, proportion that took effect.	No. of times traverses were struck.	Remarks.
	Yds.	lb.	oz.		Deg.	sec						
10-Inch Iron How. weight of shell 29lb.	600	3	..	30⅔	7¼	4	10	4	4	2/5	..	Work without traverses
	..	4	..	23	5	3½	10	2	2	1/5	..	
	800	3	8	26 2/7	7½	5	10	3	3	2/10	..	
	..	4	..	23	6¼	4½	10	1	1	1/10	..	
	600	2	8	36⅘	9¾	4½	15	4	4		3	Work traversed.
	..	3	..	30⅔	7¼	4	15	6	4	..	3	
	..	3	8	26 2/7	6½	3¾	15	9	7	..	5	
	..	4	..	23	5	3½	15	5	3	..	4	
8-Inch Iron Howitr, weight of shell 46lb.	400	1	..	46	9½	3½	20	10	12	½	..	Work without traverses.
	..	1	8	30⅔	6	3¼	10	6	7	½ near.	..	
	600	1	8	30⅔	9	4½	15	4	4	¼ do.	..	
	..	2	..	23	6¼	3¾	15	9	11	⅗	..	
	800	2	..	23	8½	5	15	4	5	¼ near.	..	
	..	2	8	18⅖	6¼	4½	15	7	7	½ do.	..	
	600	2	..	23	6¼	3¾	20	8	5	..	8	Work trav.
	..	2	8	18⅖	5½	3¼	30	12	12	..	7	

TABLE, No. 4.

With Common Shells.												
Nature of Ordnance.	Range	Charge.		Proportion the Charge bore to the Shell.	Elevat^{n} by Quadrant.	Time of Flight.	N$^{o.}$ of Rounds fired.	N$^{o.}$ of Sh^{lls} took effect.	Grazes m^{ade} along face	Of Rounds fired, propor^{n} that took effect.	N$^{o.}$ times traverses were struck.	Remarks.
	Yds	lb.	oz.		deg	sec						
$5\frac{1}{2}$-in. heavy how. wt. of Shell 16lb.	400	..	8	32	8	$3\frac{1}{2}$	15	10	13	$\frac{2}{3}$	..	Without traverses.
	..	..	12	$21\frac{1}{3}$	5	3	15	10	11	$\frac{2}{3}$	..	
	600	..	12	$21\frac{1}{3}$	9	$4\frac{3}{4}$	15	4	4	$\frac{1}{4}$ near.	..	
	..	1	..	16	$6\frac{3}{4}$	$4\frac{1}{4}$	15	3	3	$\frac{1}{5}$	..	
	..	..	12	$21\frac{1}{3}$	9	$4\frac{3}{4}$	15	2	4	..	1	traversed
	..	1	..	16	$6\frac{3}{4}$	$4\frac{1}{4}$	15	5	4	..	3	
24-pr. how. br. wt. of sh^{ll} 16lb.	400	..	6	$42\frac{2}{3}$	$7\frac{1}{2}$	$3\frac{1}{2}$	15	8	9	$\frac{1}{2}$ near.	..	Without traverses.
	..	..	9	$28\frac{4}{9}$	$4\frac{3}{4}$	$2\frac{3}{4}$	15	10	16	$\frac{2}{3}$	..	
	600	..	9	$28\frac{4}{9}$	$7\frac{1}{2}$	4	15	8	8	$\frac{1}{2}$ near.	..	
	..	..	12	$21\frac{1}{3}$	$5\frac{1}{4}$	$3\frac{3}{4}$	15	5	7	1/[illegible]	..	
	..	..	9	$28\frac{4}{9}$	$7\frac{1}{2}$	4	15	3	4	..	3	traversed
	..	..	12	$21\frac{1}{5}$	$5\frac{1}{4}$	$3\frac{3}{4}$	15	4	4	..	1	
12-pr. how. wt. of shell 8lb.	600	..	6	$21\frac{1}{2}$	8	4	10	1	4	..	..	Without traverses.
	..	..	8	16	$6\frac{1}{2}$	$3\frac{3}{4}$	10	4	4	..	..	
68-Pr. Car^{des}.	600	1	8	$30\frac{2}{3}$	$8\frac{1}{4}$	$4\frac{1}{4}$	10	6	6	$\frac{1}{2}$ near.	..	With^{out} travers^{s}

1st.

1*st.* The work was nearly on a level with the battery.

2*nd.* At a range of 400 yards, with a charge of powder $\frac{1}{32}$ of the weight of the shot, about $\frac{3}{4}$ of the rounds took effect at 600 yards with charges from $\frac{1}{32}$ to $\frac{1}{20}$, from $\frac{2}{3}$ to $\frac{1}{3}$ took effect. And at 800 yards with charges from $\frac{1}{24}$ to $\frac{1}{12}$, from $\frac{1}{3}$ to $\frac{2}{5}$ took effect.

3*d.* Ricochet batteries, therefore, should, if possible, be at a distance of 400, and not exceeding 600 yards: as from the uncertainty of firing with small charges at a greater distance, at least two-thirds of the ammunition would be thrown away.

4*th.* From the whole course of the practice it would appear that with both shot and shells, the best elevation to enfilade a work is from 6 to 9 degrees, measured above the crest of the parapet, and the charges should be regulated accordingly.

5*th.* Of 170 shells filled with powder that were fired at the work when traversed, 58 took effect, but only 33 of that number burst in the work; nevertheless the effect on the traverses was considerable; and they were much ruined. The fuzes, however, were in general cut longer than was necessary for the range: in order that time might be given for their lodging in the traverses before exploding: but this practice is not recommended.

6*th.* The times of flight are averages of the most advantageous rounds.

ROCKETS.

ROCKETS for Signals, &c.—Composition.

	Old Proportion.		*New Proportion.*	
	lbs.	oz.	lbs.	oz.
Saltpetre	4	0	4	4
Sulphur	1	0	0	12
Charcoal	1	8	2	0

Composition for the Stars.

	lbs.	oz.
Mealed powder	0	8
Saltpetre	8	0
Sulphur	2	0
Antimony	2	0
Isinglass dissolved	0	$3\frac{3}{4}$
Spirits of wine	1 pint	
Vinegar	1 quart	

Composition for rains to head sky-rockets is the same as the above for the rockets.

General Table of Sky-Rockets.

		2-Pound.	1-Pound.	$\frac{1}{2}$-Pound.	$\frac{1}{4}$-Pound.
		Inches.	Inches.	Inches.	In.
Case	Exterior diameter	2·13	1·69	1·34	1·06
Case	Interior diameter	1·529	1·214	0·961	0·761
Case	Length before driving	15·97	12·67	13·05	8·25
Length of guage for the choke		1·5	1·25	1·0	0·75
Cylinders for heading	Diameter	2·84	2·25	1·79	1·39
Cylinders for heading	Length	4·26	3·38	2·68	2·12
Cones for heading	Diameter	2·84	2·25	1·79	1·39
Cones for heading	Height	4·26	3·38	2·68	2·18
Mallet for driving.—Weight		1 lb.	38 oz.	2·1	1·10
No. of strokes		31	21	18	13

Copper Ladles for filling Sky-Rockets.

Length, $1\frac{1}{2}$ the exterior diameter of the case.

Diameter, equals the interior diameter of case.

Circumference, $\frac{3}{4}$ the interior calibre of the case.

Sky-rockets are driven with composition up to $4\frac{1}{2}$ exterior diameter of the case from the choke, and $\frac{1}{5}$ of a diameter above the composition with good clay.—They are bored and reamed up to $3\frac{1}{2}$ diameters.

Dimensions of Sticks for Rockets.—General Rules.

For rockets from half an ounce to one pound, the stick must be 60 diameters of the rocket in length: for rockets from one pound and upwards, fifty or fifty-two diameters. Their thickness at top about half a diameter, and their breadth very little more. Their square at bottom equal to half the thickness at top.

Nature of Rockets.	6-Pr	4-Pr	2-Pr	1-Pr	$\frac{1}{2}$-Pr	$\frac{1}{4}$-Pr	$\frac{1}{8}$-Pr.
	F. I.	F. I.	F. I.	F. I.	F. I.	F. I.	F. I.
Distance of poise from the point of the cone...	4 $1\frac{1}{2}$	3 9	2 9	2 1	1 $10\frac{1}{2}$	1 $8\frac{1}{2}$	1 3

Rockets of between 3 and 4 inches diameter have been observed to ascend as high as 1000 or 1200 yards; but the height of common rockets is between 450 and 600 yards; and their flight usually short of 7 seconds.

JONES, ROBINS, LAB.

General Observations on the Congreve Rockets.

Since the termination of the late war, considerable improvements have been made in the rocket system. The principal one, in fixing the stick in the axis of the rocket, by which means it can be fired through a tube, instead of being laid in a trough as formerly. The advantage of this is, that it is retained, when first ignited, in its direction until it has acquired sufficient velocity to overcome its gravity, and to continue its flight without dipping; whereas, formerly, its gravity acted so powerfully against its initial or least velocity,* as to cause it, at low angles, to dip so much as to come in contact with the ground soon after leaving the trough.

The stick, in consequence of this improvement, has been considerably shortened. When the ground was uneven or covered with brushwood, it was impossible to use the old

* The initial velocity of a rocket, contrary to the rule with all other projectiles, is its least velocity. Its greatest velocity has been proved by experiment to be nearly in the middle of its flight.—12-pr. rockets have been dug out of the ground after ranging 1260 yards, having penetrated 22 feet in a slanting direction, and from 4 to 5 feet below the surface of the ground:—several have penetrated from 15 to 19 feet in the middle of the butt, and the shell has then exploded, making a circular hole of 2 feet diameter.

 rocket

rocket at short distances; but this difficulty is now overcome. Notwithstanding, if the ground is even, the most efficacious application of the rocket is in powerful vollies from the ground, where, from 6 to 800 yards, they do not rise higher than a man's head: from 5 to 1200 yards, they range well from the tubes fixed on field carriages. The 24-pr. rocket requires about 15° for 1200 yards: the 12-pr. rather more than a degree for each 100 yards: the 6-pr. 1 degree for every 100 yards. In rocket practice, particular attention must be paid to the wind. A strong breeze in the direction of the flight of the rocket tends to bear the stick down; therefore, rather less elevation is required than when perfectly calm. A strong breeze meeting the rocket, acts in a contrary manner, and rather more elevation must be given. A strong breeze across the range, acting on the stick, throws the rocket to the windward; it must, therefore, be pointed to leeward of the object. A slant wind acts doubly, but in a smaller degree: if following the rocket on the quarter, less elevation than when calm, and a small allowance to leeward in pointing. If meeting the rocket from the right or left, a little more elevation, and a small allowance to leeward, as before. By attention to these directions, rockets, when fired in masses, will range sufficiently accurate for the purposes of actual service, where bodies of troops are the mark fired at.

The portability of the rockets in difficult countries, and the facility of projecting them, with or without carriages,

in

in quantities limited only by the means of transport, makes them a desirable weapon to accompany artillery with every army.

ROPE—is always distinguished by its circumference: thus, a two-inch rope means a rope of 2 inches in circumference.

Rule for finding the Weight of Ropes.

Multiply the square of the circumference in inches by the length in fathoms, and divide the product by 480 for the weight in cwts.—See also *Drag-ropes.*

SAN

SAND-BAGS are made about 27 inches long, and 15 diameter: 250 of these are required for each fathom of battery, or about 1680 for two guns or mortars.—See *Tonnage*.

SAP.—The sap generally commences about the second parallel, and sometimes sooner; and if the fire of the besieged is much slackened, may proceed both day and night. The sappers are usually divided into brigades of 8, and subdivided into divisions of 4 each; being the greatest number that can work at the sap at the same time. The leading sapper excavates 18 inches deep, and as much wide; the second cuts it 20 inches wider; the third cuts the second sapper's trench 18 inches deeper, leaving No. one's work to form a step, with 18 inches for a berm between the trench and the gabions. The fourth sapper cuts the trench 10 inches wider; so that the four make a trench of 4 feet wide at top, including the step, and 3 feet deep; after which, the common workmen follow, and increase it in breadth and depth equal to the other trenches. The sap may proceed at the rate of 80 fathoms in 24 hours. As this work is very hard, the half brigades relieve each other every hour,

and

and each sapper in his turn takes the lead. The whole brigade is relieved at the end of 6 hours.—See *Trenches—Parallels.*

Double Sap.—This consists of two saps made parallel, with a mound of earth left between, which is called the tongue. The gabions of one sap are placed on the right, those of the other on the left; so that after the mound of earth between the two is removed, they form a trench at least 12 feet wide at top, not including the two berms with a parapet on each side, traverses are then constructed within it.

SAUCISSONS.—See *Fascines.*

SECANT.—See table at the end of the word *Gunnery.*

SHELLS.—For Mortars and Howitzers.—Their Dimensions, Weight, &c.*

Nature.	Weight*.	Diameter	Powder contained in Shells.	Powder for Bursting.	Diam.r of Fuze Hole. Outside.	Diam.r of Fuze Hole. Inside.	Thickness of Metal.	Weight Loaded.
	lbs. oz.	In.	lbs. oz.	lbs. oz.	Inches.	Inches.	Inches.	lbs. oz.
13-Inch ——	192 to 195	12¾	10 4	6 12	1·83	1·696	2·05	200 0
10 ——	88 to 90	9¾	4 5	2 10	1·577	1·45	1·575	92 0
8 ——	42 to 44	7¾	2 12	1 14	1·219	1·127	1·2	46 0
5½ ——	15¾	5¼	1 —	— 12	0·894	·826	0·822	16 0
4⅖ ——	8	4⅕	— 7	— 5	0·832	·769	0·653	8 7
H. Gren. {	3 11	3·49						
	1 13	2·77		— 1½				

* See new table of guages.

French Shells, in French Weights and Measures.

Inches.	lbs.				Lines Po.	Lines Po.	Lines.	
12-Inch ——	150	12	17 —	5 —	15 9	15 —	16	
10 ——	100	10	10 —	3 —	15 9	15 —	16	
8 ——	43	8	4 1	1 —	12 —	11 —	10	
6 ——	23	6	2 8	— 12	11 —	10 6	10	

Dimensions of Shells for Guns and Carronades made with an equal Thickness of Metal.

Nature			42-Pr.	32	24	18	12
			Inches.	Inches.	Inches.	Inches.	Inches.
Guns*	Diameter of the shell	Exterior —	6·684	6·105	5·547	5·05	4·4
		Interior —	4·404	4·005	3·767	3·4	2·8
	Thickness of metal	— oz.	1·14	1·05	0·89	0·82	0·8
	Diameter of fuze hole	Exterior —	0·894	0·894	0·893	0·832	0·832
		Interior —	0·826	0·826	·826	·76	·769
	Powder for bursting	— oz.	14	11	12	9	5½
Carronades*	Diameter of the shell	Exterior —	6·64	6·05	5·48	4·935	4·295
		Interior —	4·36	3·95	3·48	3·235	2·695
	Thickness of metal	— —	1·14	1·35	1·	·85	0·98
	Shell's weight	— lbs.		22		12	
	Contains powder	— oz.		12½		9	
	Powder for bursting	— oz.		10		7	

* See new Table of Guages.

The

The following Shells may also be fired from Guns.

Hand-grenades	from	6-Prs.
$4\frac{2}{6}$-Shells	——	12-Prs.
$5\frac{1}{4}$-Shells	——	24-Prs.
8-Inch	——	68-Pr. Carronades.

Shells may likewise be thrown from guns to short distances, in cases of necessity, though the bore be not of a diameter sufficient to admit the shell.—For this purpose the gun may be elevated to any degree that will retain the shell upon its muzzle, which may be assisted by a small line going from the lugs of the shell round the neck of the gun.—To produce a greater effect, the space between the shell and the charge may be filled with wads or other substance. LOMBARD.

Shells are likewise sometimes quilted into grape.—See the word *Shot*.

For the method of proving shells—see *Proof*.

To find the Weight of a Shell of Iron.

Take nine sixty-fourths of the difference of the cubes of the external and internal diameters for the weight of the shell.

To find how much Powder will fill a Shell.

Divide the cube of the internal diameter of the shell in inches by 57·3, for the pounds of powder.

To

To find the Size of a Shell to contain a given Weight of Powder.

Multiply the pounds of powder by 57·3, and the cube root of the product will be the diameter in inches.

The Germans do not name their shells from the diameter of the bore which receives them, but from the weight of a stone ball that fits the same bore as the shell.—Thus, a 7lb. howitzer admits a stone ball of that weight; the shell for this, weighs 15 lbs. and answers to the English $5\frac{1}{2}$-inch· The 30 lbs. howitzer shell weighs 60 lbs. and is rather more than 8 inches in diameter.

Note—Shells were, till lately, made thicker at the bottom than at the fuze hole; but are now cast of the same thickness throughout, and are found to burst into a greater number of pieces in consequence.

SHOT.

Rules for finding the Number in any Pile of Shot or Shells.

A Triangular Pile.

Multiply the base by the base plus 1, this product by the base plus 2, and divide by 6.

Square Pile.

Multiply the bottom row by the bottom row plus 1, and this product by twice the bottom row plus 2, and divide by 6.

Rectangular Piles.

Multiply the breadth of the base by itself plus 1, and this

this product by 3 times the difference between the length and breath of the base, added to twice the breadth plus 1, and divide by 6.

General Rule.

The simplest method of computing any complete pile, whether square, rectangular, or triangular, is, by multiplying the sum of the three parallel ridges by $\frac{1}{3}$ of the number of shot in the triangular face.

Note.—The three parallel ridges of a *square* pile are the two exterior rows of the base and the top shot, the axis of which is parallel to the others.—In a *rectangular* pile, the two exterior rows of the base lengthwise, and the top ridge. In a *triangular* pile, the exterior base row on any side, the opposite shot at the angle, and the top shot.

The number of shot in the triangular face is found by multiplying the number of shot in the base row of that face, plus 1, by half the number in the base row. When the number of shot in the triangular face will not divide by 3, the sum of the three parallel ridges invariably will. Thus, keeping in mind which are the three parallel ridges, you have a general rule for all complete piles.

Incomplete Piles.

Incomplete piles being only frustrums, wanting a similar small pile on the top, compute first the whole pile as if complete, and also the same pile wanting at top, and then subtract the one number from the other.

Table

*Tables of Shot Piles.**

	3	4	5	6	7	8	9	10
Tr.	10	20	35	56	84	120	165	220
3	14							
4	20	30						
5	26	40	55					
6	32	50	70	91				
7	38	60	85	112	140			
8	44	70	100	133	168	204		
9	50	80	115	154	196	240	285	
10	56	90	136	175	224	276	330	385
11	62	100	145	196	252	312	375	440
12	68	110	160	217	280	348	420	495
13	74	120	175	238	308	384	465	550
14	80	130	190	259	336	420	510	605
15	86	140	205	280	364	456	555	660
16	92	150	220	301	392	492	600	715
17	98	160	235	322	420	528	645	770
18	104	170	250	343	448	564	690	825
19	110	180	265	364	476	600	735	880
20	116	190	280	385	504	636	780	935
21	122	200	295	406	532	672	825	990
22	128	210	310	427	560	708	870	1045
23	134	220	325	448	588	744	915	1100
24	140	230	340	469	616	780	960	1155
25	146	240	355	490	644	816	1005	1210
26	152	250	370	511	672	852	1050	1265
27	158	260	385	532	700	888	1095	1320
28	164	270	400	553	728	924	1140	1375
29	170	280	415	574	756	960	1185	1430
30	176	290	430	595	784	996	1230	1485

* Tr. indicates a triangular pile, the base row of which is immediately above; thus, the base row being 9, the number in the pile is 165; and in any other shaped pile, for

 Table

	11	12	13	14	15	16	17	18
Tr.	286	364	455	560	680	816	969	1140
11	506							
12	572	650						
13	638	728	819					
14	704	806	910	1015				
15	770	884	1001	1120	1240			
16	836	962	1092	1225	1360	1496		
17	902	1040	1183	1330	1480	1632	1785	
18	968	1118	1274	1435	1600	1768	1938	2109
19	1034	1196	1365	1540	1720	1904	2091	2280
20	1100	1274	1456	1695	1840	2040	2244	2451
21	1166	1352	1547	1750	1960	2176	2397	2622
22	1232	1430	1638	1855	2080	2312	2550	2793
23	1298	1508	1729	1960	2200	2448	2703	2964
24	1364	1586	1820	2065	2320	2584	2856	3135
25	1430	1664	1911	2170	2440	2720	3009	3306
26	1496	1742	2002	2275	2560	2856	3162	3477
27	1562	1820	2093	2380	2680	2992	3315	3648
28	1628	1898	2184	2485	2800	3128	3468	3819
29	1694	1976	2275	2590	2920	3264	3621	3990
30	1760	2054	2366	2695	3040	3400	3774	4161
31	1826	2132	2457	2800	3160	3536	3927	4332
32	1892	2210	2548	2905	3280	3672	4080	4503
33	1958	2288	2639	3010	3400	3808	4233	4674
34	2024	2366	2730	3115	3520	3944	4386	4845
35	2090	2444	2821	3220	3640	4080	4539	5016
36	2156	2522	2912	3325	3760	4216	4692	5187
37	2222	2600	3003	3430	3880	4352	4845	5358
38	2288	2678	3094	3535	4000	4488	4998	5529
39	2354	2756	3185	3640	4120	4624	5151	5700
40	2420	2834	3276	3745	4240	4760	5304	5871

example, 17 by 9, opposite 17 and in the column under 9, will be found the number 645, looking always for the smaller number above.

	19	20	21	22	23	24	25	26
Tr.	1330	1540	1771	2024	2300	2600	2925	3276
19	2470							
20	2660	2870						
21	2850	3080	3311					
22	3040	3290	3542	3795				
23	3230	3500	3773	4048	4324			
24	3420	3710	4004	4301	4600	4900		
25	3610	3920	4235	4554	4876	5200	5525	
26	3800	4130	4466	4807	5152	5500	5850	6201
27	3990	4340	4697	5060	5428	5800	6175	6552
28	4180	4550	4928	5313	5704	6100	6500	6903
29	4370	4760	5159	5566	5980	6400	6825	7254
30	4560	4970	5390	5819	6256	6700	7150	7605
31	4750	5180	5621	6072	6532	7000	7475	7956
32	4940	5390	5852	6325	6808	7300	7800	8307
33	5130	5600	6083	6578	7084	7600	8125	8658
34	5320	5810	6314	6831	7360	7900	8450	9009
35	5510	6020	6545	7084	7636	8200	8775	9360
36	5700	6230	6776	7337	7912	8500	9100	9711
37	5890	6440	7007	7590	8188	8800	9425	10062
38	6080	6650	7238	7843	8464	9100	9750	10413
39	6270	6860	7469	8096	8740	9400	10075	10764
40	6460	7070	7700	8349	9016	9700	10400	11115
41	6650	7280	7931	8602	9292	10000	10725	11465
42	6840	7490	8162	8855	9568	10300	11050	11817
43	7030	7700	8393	9108	9844	10600	11375	12168
44	7220	7910	8624	9361	10120	10900	11700	12519
45	7410	8120	8855	9614	10396	11200	12025	12870
46	7600	8330	9086	9867	10672	11500	12350	13221
47	7790	8540	9317	10120	10948	11800	12675	13572
48	7980	8750	9548	10373	11224	12100	13000	13923
49	8170	8960	9779	10626	11500	12400	13325	14274
50	8360	9170	10010	10879	11776	12700	13650	14625

	27	28	29	30	31	32	33	34
Tr.	3654	4060	4495	4960	5456	5984	6545	7140
27	6930							
28	7308	7714						
29	7686	8120	8555					
30	8064	8526	8990	9455				
31	8442	8932	9425	9920	10416			
32	8820	9338	9860	10385	10917	11440		
33	9198	9744	10295	10850	11408	11968	12529	
34	9576	10150	10730	11315	11904	12496	13090	13685
35	9954	10556	11165	11780	12400	13024	13651	14280
36	10332	10962	11600	12245	12896	13552	14212	14875
37	10710	11368	12035	12710	13392	14080	14773	15470
38	11088	11774	12470	13175	13888	14608	15334	16065
39	11466	12180	12905	13640	14384	15136	15895	16660
40	11844	12586	13340	14105	14880	15664	16456	17255
41	12222	12992	13775	14570	15376	16192	17017	17850
42	12600	13398	14210	15035	15872	16720	17578	18445
43	12978	13804	14645	15500	16368	17248	18139	19040
44	13356	14210	15080	15965	16864	17776	18700	19635
45	13734	14616	15515	16430	17360	18304	19261	20230
46	14112	15022	15950	16895	17856	18832	19822	20825
47	14490	15428	16385	17360	18352	19360	20382	21420
48	14868	15834	16820	17825	18848	19888	20944	22015
49	15246	16240	17255	18290	19344	20416	21505	22610
50	15624	16646	17690	18755	19840	20944	22066	23205
51	16002	17052	18125	19220	20336	21472	22627	23800
52	16380	17458	18560	19685	20832	22000	23188	24395
53	16758	17864	18995	20150	21328	22528	23749	24990
54	17136	18270	19430	20615	21824	23056	24310	25585
65	17514	16676	19865	21080	22320	23584	24871	26180
56	17892	19082	20300	21545	22816	24112	25432	26775
57	18270	19488	20735	22010	23312	24640	25993	27370
58	18648	19894	21170	22475	23808	25168	26554	27965
59	19026	20300	21605	22940	24304	25696	27115	28560
60	19404	20706	22040	23405	24800	26224	27676	29155

	35	36	37	38	39	40	41	42
Tr.	7770	8436	9139	9880	10660	11480	12341	13244
35	14910							
36	15540	16206						
37	16170	16872	17575					
38	16800	17538	18278	19019				
39	17430	18204	18981	19760	20540			
40	18060	18870	19684	20501	21320	22140		
41	18690	19536	20387	21242	22100	22960	23821	
42	19320	20202	21090	21983	22880	23780	24682	25585
43	19950	20868	21793	22724	23660	24600	25543	26488
44	20580	21534	22496	23465	24440	25420	26404	27391
45	21210	22200	23199	24206	25220	26240	27265	28294
46	21840	22866	23902	24947	26000	27060	28126	29197
47	22470	23532	24605	25688	26780	27880	28987	30100
48	23100	24198	25308	26429	27560	28700	29848	31003
49	23730	24864	26011	27170	28340	29520	30709	31906
50	24360	25530	26714	27911	29120	30340	31570	32809
51	24990	26196	27417	28652	29900	31160	32431	33712
52	25620	26862	28120	29393	30680	31980	33292	34615
53	26250	27528	28823	30134	31460	32800	34153	35518
54	26880	28194	29526	30875	32240	33620	35014	36421
55	27510	28860	30229	31616	33020	34440	35875	37324
56	28140	29526	30932	32357	33800	35260	36736	38227
57	28770	30192	31635	33098	34580	36080	37597	39130
58	29400	30858	32338	33839	35360	36900	38458	40033
59	30030	31524	33041	34580	36140	37720	39319	40936
60	30660	32190	33744	35321	36920	38540	40180	41839
61	31290	32856	34447	36062	37700	39360	41041	42742
62	31920	33522	35150	36803	38480	40180	41902	43645
63	32550	34188	35853	37544	39260	41000	42763	44548
64	33180	34854	36556	38285	40040	41820	43624	45451
65	33810	35520	37259	39026	40820	42640	44485	46354
66	34440	36186	37962	39767	41600	43460	45346	47257
67	35070	36852	38665	40508	42380	44280	46207	48160
68	35700	37518	39368	41249	43160	45100	47068	49063
69	36330	38184	40071	41990	43940	45920	47829	49966
70	36960	38850	40774	42731	44720	46740	48790	50869

	43	44	45	46	47	48	49	50
Tr.	14190	15180	16215	17296	18424	19600	20825	22100
43	27434							
44	28380	29370						
45	29326	30360	31395					
46	30272	31350	32430	33511				
47	31218	32340	33465	34592	35720			
48	32164	33330	34500	35673	36840	38024		
49	33110	34320	35535	36754	37976	39200	40425	
50	34056	35310	36570	37835	39104	40376	41650	42925
51	35002	36300	37605	38916	40232	41552	42875	44200
52	35948	37290	38640	39997	41360	42728	44100	45475
53	36894	38280	39675	41078	42488	43904	45325	46750
54	37840	39270	40710	42159	43616	45080	46550	48025
55	38786	40260	41745	43240	44744	46256	47775	49300
56	39732	41250	42780	44321	45872	47432	49000	50575
57	40678	42240	43815	45402	47000	48608	50225	51850
58	41624	43230	44850	46483	48128	49784	51450	53125
59	42570	44220	45885	47564	49256	50960	52675	54400
60	43516	45210	46920	48645	50384	52136	53900	55675
61	44462	46200	47955	49726	51512	53312	55125	56950
62	45408	47190	48990	50807	52640	54488	56350	58225
63	46354	48180	50025	51888	53768	55664	57575	59500
64	47300	49170	51060	52969	54896	56840	58800	60775
65	48246	50160	52095	54050	56024	58016	60025	62050
66	49192	51150	53130	53131	47152	59192	61250	63325
67	50138	52140	54165	56212	58280	60368	62475	64600
68	50184	53130	55200	57293	59408	61544	63700	65875
69	52030	54120	56235	58374	60536	62720	64925	67150
70	52976	55110	57270	59455	61664	63896	66150	68425
71	53922	56100	58305	60536	62792	65072	67375	69700
72	54868	57090	59340	61617	63920	66248	68500	70975
73	55814	58080	60375	62698	65048	67424	69825	72250
74	56760	59070	61410	63779	66176	68600	71050	73525
75	57706	60060	62445	64860	67304	69776	72275	74800
76	58652	61050	63480	65941	68432	70952	73500	76075
77	59598	62040	64515	67022	69560	72128	74725	77350
78	60544	63030	65550	68103	70688	73304	75950	78625
79	61490	64020	66585	69184	71816	74480	77175	79900
80	62436	65010	67620	70265	72944	75656	78400	81175

Rules for finding the Dimensions and Weight of Shot.

The weight and dimensions of shot or shells might be found by means of their specific gravities, (see the word *Gravity*:) but they may be found still easier, by means of the experimented weight of a ball of a given size, from the known proportion of similar figures, namely, as the cubes of their diameters.

1st. *To find the Weight of an Iron Ball from its Diameter.*—An iron ball of 4 inches diameter weighs 9 lbs. and the weights being as the cubes of their diameters, it will be as 64 (the cube of 4) is to 9, so is the cube of the diameter of any other ball to its weight.

2d. *To find the Weight of a Leaden Ball.*—A leaden ball of $4\frac{1}{4}$ inches diameter weighs 17 lb.—Therefore, as the cube of $4\frac{1}{4}$ is to 17, (as 9 to 2 nearly,) so is the cube of the diameter of any leaden ball to its weight.

3d. *To find the Diameter of an Iron Ball.*—Multiply the weight by $7\frac{1}{9}$, and the cube root of the product will be the diameter.

4th. *To find the Diameter of a Leaden Ball.*—Multiply the weight by 9, and divide the product by 2; and take the cube root of the quotient for the diameter.

Table

*Table of Diameters of English Round Shot.**

Nature.	68	42	32	24	18	12	9	6	3	1
Inches.	8	6·684	6·105	5·475	5·043	4·403	4·000	3·498	2·775	1·92

* See new Table of Guages.

Diameters of French Iron Round Shot, in English Inches.

Nature.	36	24	16	12	8	4
Inches.	6·648	5·808	5·074	4·610	4·027	3·196

Table

Table of English Case Shot for different Service.

Sea Service.

Nature.	Weight of each Shot.	Number in each Case.	Weight of each Case filled.	
Prs.	oz.	N°.	lbs.	oz.
32	8	70	33	8
24	8	42	22	15
18	6	42	16	8
12	4	42	11	5
9	3	44	8	9
6	2	40	5	2
4	2	28	4	
3	2	20	2	15
1	$1\frac{1}{4}$	12	1	$2\frac{1}{4}$

Common Land Service.

Nature.	Weight of each Shot.	Number in each Case.	Weight of each Case filled.	
Prs.	oz.	N°.	lbs.	oz.
24	4	84	21	11
12	2	84	12	1
6	$1\frac{1}{2}$	55	5	$10\frac{1}{2}$
3	$1\frac{1}{4}$	52	2	14

Carronades.

Nature.	Weight of each Shot.	Number in each Case.	Weight of each Case filled.	
Prs.	oz.	N°.	lbs.	oz.
68	8	90	46	2
42	8	66	32	8
32	8	40	21	4
24	8	32	16	1
18	6	31	12	2
12	4	32	8	2

Tier Shot for Field Service.

Nature.	oz.	N°.	lbs.	oz.
12-Pr.	18	15	18	8
Med.	$6\frac{1}{2}$	42	17	11
6-Pr.	$8\frac{1}{2}$	15	9	
Med.	$3\frac{1}{2}$	42	8	14
3-Pr.	$4\frac{1}{2}$	15	4	10
Med.	$1\frac{1}{2}$	42	4	6
12-Pr.	14	12	14	14
Light	$6\frac{1}{2}$	34	14	11
6-Pr.	$8\frac{1}{2}$	12	7	3
Light	$3\frac{1}{2}$	34	7	7
3 Pr.	$4\frac{1}{2}$	12	3	10
Light	$1\frac{1}{2}$	34	3	11

Table of Case Shot—Continued.

	For Mortars.			Howitzers.		
Nature.	Weight of each Shot.	Number of Shot in each.	Weight of Case filled.	Weight of each Shot.	Number of Shot in each.	Weight of Case filled.
Inches.	oz.	No.	lbs. oz.	oz.	No.	lbs. oz.
10		170	91 8			
8	6	90	38 4	6	90	38 8
$5\frac{1}{2}$	3	55	12 6	3	55	12 8
$4\frac{2}{5}$	2	55	8 $1\frac{3}{4}$	2	55	8 2

If at any time case shot cannot be procured, or tin for the purpose of making the cases, a very good substitute may be made by the following method:

Take a wooden bottom of $\frac{1}{2}$ of an inch less than the ordinary diameter, roll strong cartridge paper, which has been spunged over two or three times with water and nearly dry, on a former of the same diameter, to the proper dimensions; paste down the exterior edge of the cylindrical case, and nail it on to the bottom with small tacks; when dry, pour in a small quantity of hot pitch and rosin, or kitt composition; then a layer of musquet-balls; continuing them, alternately, till the case is filled in length equal to two diameters of a round shot, independent of the wooden bottom; over the last tier put another bottom, two inches in thickness, and nail it on.

Table of Grape Shot for Sea and Land Service.

Nature.	Weight of each Shot.		Total Weight of the Grape complete.	
	lbs.	oz.	lbs.	oz.
42-Pounders —	4	—	46	6
32 ——— —	3	—	34	1
24 ——— —	2	—	25	5
18 ——— —	1	8	19	15½
12 ——— —	1	—	10	15
9 ——— —	—	13	7	6
6 ——— —	—	8	5	8½
4 ——— —	—	6	3	14½
3 ——— —	—	4	2	10½
½ ——— —	—	¾ lead	—	8¾

Table of New Pattern Grape Shot, with 4 Iron Plates, Pin, Nut, and 9 Shot.

Nature.	Length of Grape.		Diameter of Plates.		Weight of each Shot.		Weight of 9 Shot.		Weight of Plates, Pin, and Nut.		Total Weight of the Grape.	
	in.	dec.	in.	dec.	lbs.	oz.	lbs.	oz.	lbs.	oz.	lbs.	oz.
32-Pr. ..	9		6	1	2	12	24	12	9	0	33	12
24 — ..	7	6	5	5	1	13	16	5	7	12	24	1
18 — ..	6	7	5		1	6	12	6	5	9	17	15
12 — ..	6	2	4	1	..	15	8	7	3	11	12	2
9 — ..	5	7	4		..	13	7	5	2	7	9	12
6 — ..	4	7	3	5	..	8	4	8	1	12	6	4

MAHARAJA SERFOJI'S

Each

Each plate (with the exception of the bottom, in which there are only 3) has 6 holes perforated to receive the tops of one tier of shot, and the bottoms of another. The pin passes through the center of each plate, and the nut fastens the whole together. This plan makes them very portable, and easily put together when required.

Small shells, as $4\frac{2}{5}$ inches, and hand-grenades, were quilted into grape for 13-inch mortars, at Gibraltar.—The fuzes were turned inwards next the iron tampion, and leaders of quick-match, for communicating fire to the fuzes, were introduced through holes made in the wooden bottom, and placed as near the fuze as possible, in the centre of the grape.—These answered very well for short ranges.

SHAND.

Hot Shot.—The powder for firing with hot-shot must be in strong flannel cartridges, without any holes, lest some grains should remain in the bore, in putting the cartridge home.—Over the powder must be rammed a good dry wad, then a damp one, and then the hot-shot; and if the gun lays at a depression, there must be a wad over the shot, which may be rammed home.—If the above precautions be attended to, the gun may be pointed after being loaded, without the smallest danger; as it is well known that the shot will grow cold in the gun, without burning more than a few threads of the wads next it.—This is not the mode usually taught of loading with hot-shot, but is that which

was

was practised during the siege of Gibraltar.—Mons$^{r.}$ Durtubie proposes putting the shot, when heated, into a tin cannister, as an effectual method of preventing accidents.

The grates usually made for heating shot will generally make them red hot in ¾ of an hour.

SIEGE.—For the operations of a siege, see *Artillery.*

Iron ordnance are preferable to brass, for the purpose of besieging, in nearly a fourfold proportion, as was fully exemplified in the two sieges of Badajos, Ciudad Rodrigo, and St. Sebastian. In the first siege of Badajos, the brass guns, which were Portuguese, and were brought from Elvas, soon proved unserviceable; the bore losing its cylindric form: at St. Sebastian the guns used were English iron ones, and fully answered the purpose. Ciudad Rodrigo was taken by assault (after two breaches had been formed) by the Duke of Wellington, in 18 days less time than Marshal Massena took to effect the same. Badajos was taken by the Duke of Wellington (after 3 breaches were made) in 21 days less time than Marshal Mortier employed. Mortier used brass guns, the English chiefly iron.

Monsieur Bousmard, a late French writer, says, that in battering with 24-pounder brass guns, only from 100 to 120 rounds per gun can be fired in a day. From the English iron guns used at St. Sebastian and Badajos, the average of firing in 15½ hours per day was from 300 to 350 rounds per gun: the bores of the iron guns kept their form, but the

the vents were much enlarged; nevertheless, at the last siege of St. Sebastian, they fired with great accuracy over the heads of the troops on the breach.

An anonymous, though intelligent officer of artillery, who has written on the advantages to be derived from using iron ordnance in preference to brass in besieging, gives the following proportion of guns and ammunition for an artillery or accelerated siege, with either one or two days battering in breach, and three or four days ricochet firing.

	Disposition of the Ordnance.	24-Pr. Iron.	68-Pr. Carron.	10-Inch Mortars, Iron.	Total of Pieces.
		Ordnance for first Ricochet			
Bastions and covered-way.	To ricochet 3 faces of 2 bastions at 4 guns each	12	..	..	12
	Ditto right face of bastion to be breached........	2	2	..	4
	Ditto 4 opposite covered-ways of the 2 bastions at 2 guns each........	8	..	..	8
	Do. flank of bastion looking to the breach, at 4 guns	4	..	..	4
	Do. flanks of bastions to be breached at 2 guns each	4	..	..	4
	Direct fire of 4 guns to destroy the flank of bastion looking to the bastion breach..	4	..	..	4
Ravelins & covered-ways.	To ricochet the face of the intermediate ravelin looking to the breach......	2	2	..	4
	Ditto right face of the intermediate ravelin, and that of the left ravelin at 2 guns each........	4	..	..	4
	Ditto the opposite covered-ways of the 3 faces of ravelins at 2 guns each	6	..	..	6
	Mortars to play on bastions to be breached..........			8	8
	Ditto on the other bastion....			3	3
	Ditto on the intermediate ravelin			5	5
	First ricochet for 48 hours....	46	4	16	66

Disposition of the Ordnance.	Ordnance for the 2d ricochet & breaching.			
	24-Prs. Iron.	68-Pr. Carron. Iron.	10-Inch Mortars Iron.	Total of Pieces
Of the foregoing ordnance may be transferred to the breaching battery.				
From the 3 faces of the 2 bastions 2 guns from each	6	..	..	6
From 2 of their opposite covered-ways at 2 guns	4	..	.	4
From 2 flanks of 2 bastions at 2 guns each	4	..	..	4
From 1 covered-way of intermediate ravelin at 2 guns	2	..	..	4
	16			16
Add ordnance to complete the breaching battery to 50 24-prs.	34	..	..	34
Remaining in battery for 2d ricochet, &c.	30	4	16	50
Maximum of ordnance for the siege.	80	4	16	10

The minimum of ordnance for such a siege should not be less than 90 pieces, of which 46 guns, 4 carronades, and 16 mortars, or 66 pieces, as above, may be employed for the first 48 hours in ricochet, &c. and 20 guns, 4 carronades, and 16 mortars, or 40 pieces, may be for the second;

second; thus making a total of 50 24-pounders for breaching 20 24-prs. 4 carronades, and 16 mortars for second ricochet, &c. being 70 24-prs. 4 carronades, and 16 10-inch mortars, or 90 pieces.

Some iron howitzers of 8 and 10-inch bore, and 6 calibres in length, have been lately cast of iron; it is recommended to substitute them for the 68-pounder carronades.

Ammunition for the Accelerated Siege.

	Rounds of Ammunition, and Pounds of Powder.										
	24-Prs.					68-Pr. Carronades, or 8 inch Howitz.				Total 8-inch Shells.	Total Pounds of Powder.
	Round Shot.	Spherical Case	3-Pr. Grape.	Large Comm^n Case.	Total for 24-Pounders.	8-inch Comm^l Shells.	Spherical Case	Common Case	Total 8-inch Ammunition.		
For first ricochet 48 hours........	11040	2668	..	92	13800	600	584	16	1200	3840	52072
For second ricochet 48 hours......	7200	1740	..	60	9000	600	584	16	1200	3840	44264
For 2 days breaching with 50 24-prs.	29500	..	500	..	30000	..	..	..	..	..	240000
Maximum of ammunition	47740	4408	500	152	52800	1200	1168	32	2400	7680	336336
Deduct ammunition for 1 day's battering, and 1 day ricochet..	18350	870	250	30	19500	300	292	8	600	1920	142132
Minimum of Amm^n being 1 day's battering, and 3 days' ricochet.	29390	3538	250	122	33300	900	876	24	1800	5760	124204
Rounds per piece for maximum, and lbs. of powder, $\frac{1}{3}$ spare added	597	55	6	2	660	300	292	8	600	480	448448
Ditto for minimum, and $\frac{1}{3}$ spare of powder....................	367	45	3	2	417	225	219	6	440	360	258938

The ammunition required for this siege would therefore be only the minimum quantity with 100 pieces of cannon, and for one day's battering.

For ricochet, each 24-pounder to fire 150 rounds in the 24 hours, of which 120 to be round shot, 20 spherical case, and one large common case. The charges for the round shot to be from 12 to 16 oz. that for spherical case $\frac{1}{8}$, for common case $\frac{1}{3}$, and for bursting shells 1 lb.

For battering, the 24-pounders may fire 300 rounds during day-light, of which 295 round shot, and 5 3-pounder grape shot, the latter (in case of necessity) to fire on the breach at night, to prevent clearing or retrenching it, or on the same ravelin, just before the troops assault, charge $\frac{1}{3}$.

For 68-pounder carronades, or 8-inch howitzers, 150 rounds in the 24 hours, of which 75 to be common 8-inch shells, 73 spherical case, and 2 large common case; charges from 3 to 5 lbs. of powder; and for bursting shells, common at 2 lbs. spherical at 1 lb.

For 10-inch mortars, 120 common shells in the 24 hours; charges for bursting shells calculated at 6 lbs. per shell.

So few howitzers or carronades are given in the proportion of ordnance, and so many 24-pounders, since the latter answers the double purpose of throwing shot or shells in ricochet, and can be employed in battering from a distance, which the howitzer or carronade cannot.

It is evident the above would not be a sufficiency of ammunition

ammunition for a regular siege, which for each 24-pounder should be from 1200 to 1500 rounds per gun, 1000 per howitzer, and 800 per mortar; therefore should such a train be embarked, which, with the addition of some perriers and small mortars, would be a sufficient proportion of ordnance for the operation. In case the place to be besieged be not precisely known, it would be prudent to embark this extra ordnance *(i. e. the maximum)* and ammunition, which would remain on board-ship, if not wanted.

Note.—The ammunition estimated for an artillery siege, is three times more than usually given for enfilades with guns and howitzers; twice more than for mortars; and four times more than was employed with brass ordnance to batter in breach.

In this estimate of ordnance, not a single piece is given as spare, as none will be destroyed by their own fire, and the few rendered unserviceable by being struck may be replaced in the breaching batteries from the ricochet batteries, and if in the latter can be spared.

SINES.—See table of *Natural Sines*, at the end of the word *Gunnery*.

SMOKE-BALLS.—See *Composition.*—The mealed powder to be spread on a table; the saltpetre, reduced to powder, is then to be sifted over it, and well mixed with the

the hands; the pitch and tallow to be put into an iron pot, over the fire, and stirred till all is dissolved, and made very hot; then put into a copper pan with two handles; set this pan into another with warm water, to keep the composition hot; then put in the saltpetre and gunpowder, and let them be well mlxed: in filling the paper, or iron shells, if a 13-inch, when about a quarter full, put in 2 oz. of sulphur and 2 oz. of sea-coal, well mixed; do the same when half and three quarters full, for a 10-inch, 1 oz. of each; and for an 8-inch, ½ oz. as before: put in a plug, to keep the hole open; when cold, take it out, and prime with fuze composition.

Composition for smaller Shells of Iron or Paper.

	lbs.		lbs.
Corned powder	10	Saltpetre	2
Pitch	8	Sea-coal	3
Tallow	1	Antimony	2

SOUND.—The medium velocity of sound is nearly at the rate of a mile, or 5280 feet in 4⅔ seconds; or a league in 14 seconds; or 13 miles in one minute.—But sea miles are to land miles nearly as 7 to 6: therefore sound moves over a sea mile in 5¾ seconds nearly; or a sea league in 16 seconds. HUTTON.

Sound flies 1142 feet in one second.

FLAMESTEAD.

It

It is a common observation, that persons in good health have about 75 pulsations at the wrist in a minute, consequently in 75 pulsations sound flies about 13 land miles, or $11\frac{1}{2}$ sea miles, which is about 1 land mile in 6 pulsations, and 1 sea mile in 7 pulses; or a league in 20 pulses.

HUTTON.

The velocity of sound does not very much vary, whether it goes with the wind or against it.—As sound moves vastly swifter than the wind, the acceleration it can thereby receive can be but inconsiderable; and the chief effect we can perceive from the wind is, that the sound will be carried to a greater distance by it.—Sound will be louder in proportion to the condensation of the air.—Water is one of the greatest conductors of sound; it can be heard nearly twice as far as on land. HUTTON.

Table of Charge, Elevation, Length of Fuze, &c. for firing Spherical Case Shot. Woolwich, 1819.

Range.	Charge.	Elevation	Fuze.	Charge.	Elevation	Fuze.	Charge.	Elevation	Fuze.
	24-Pr. 130 Musquet Balls.			18-Pr. 90 Musq. Balls.			Medium 12-Pr. 63 M. Balls.		
Yds.	lb.	deg.	in dec.	lb.	deg.	in. dec.	lbs.	deg.	in. dec.
650	6	$1\frac{1}{4}$	·2	$4\frac{1}{2}$	$1\frac{1}{4}$	·2	4	$1\frac{1}{4}$	·2
900	..	$1\frac{3}{4}$	·35	..	2	·4	..	$1\frac{3}{4}$	·4
1100	..	$2\frac{1}{2}$	·5	..	3	·575	..	$2\frac{1}{2}$	·575
	Lt. 12-pr. 63 Musquet Balls.			9-Pr. 41 Musquet Balls.			Heavy 6-Pr. 27 Musq. Balls.		
650	3	$1\frac{1}{2}$	·275	3	$1\frac{1}{4}$	·29	2	$1\frac{1}{2}$	·225
900	..	2	·475	..	$1\frac{3}{4}$	·4	..	$1\frac{3}{4}$	·45
1100	..	$3\frac{1}{4}$	·65	..	$2\frac{1}{2}$	·6	..	$2\frac{3}{4}$	·65
	Lt. 6 Pr. 27 Musq. Balls.			Heavy 3-Pr. 11 Musquet Balls.			Light 3-Pr. 11 Musq. Balls.		
650	$1\frac{1}{2}$	$1\frac{1}{2}$	·3	1	$1\frac{3}{4}$	·3	$\frac{3}{4}$	2	·3
900	..	2	·5	..	$2\frac{1}{2}$	·6	..	$3\frac{1}{4}$	·6
1100	..	$2\frac{3}{4}$	·65	..	..	..	..		
	68-Pr. Carron. 377 M. Balls.			8-Inch Howit. 377 M. Balls.			Heav. $5\frac{1}{2}$-In. How. 130 Musq. Balls.		
650	4	$2\frac{1}{2}$	·4	4	$2\frac{3}{4}$	·35	2	$3\frac{1}{4}$	·45
900	..	$3\frac{1}{2}$	·6	..	$3\frac{1}{2}$	·6	..	$4\frac{3}{4}$	·65
1100	..	5	·85	..	6	1·0	..	$6\frac{1}{4}$	·85
	Lt. $5\frac{1}{2}$ Howrs.			24-Pr. Howit.			12-Pr. Howitzer.		
650	1	$5\frac{3}{4}$	·6	$2\frac{1}{2}$	2·15	·35	$1\frac{1}{4}$	2·5	·3
900	..	8	·9	..	3·45	·6	..	3·30	·55
1100	..	10	1·35	..	4·30	·75	..	5·15	·8
1200	..	..	..	..	5·30	·8	..	5·50	·9

Table

Table of Service, Charges, Bursting Powder, Weights, &c. of Spherical Case Shot.

Nature.		Charge. lb. oz.	Bursting lowder. oz. dr.	Weight of Shells empty. lbs. oz.	Weight of Sh^{lls} filled lb. oz.	N$^{o.}$ of Balls.
8-In.	Carronades	5 12	15 0	31 5	58 7	377
	Howitzers.	3 8				
42-Pr.	Carronades.	3 8	7 8	20 0	37 10	261
	Guns.	14 8				
32-Pr.	Carronades	2 10	7 0	14 12	27 1	176
	Guns.	10 11				
24-Pr.	Carronades	2 ..	6 0	11 0	19 11	130
	Guns	8 ..				
	Howitzers .	2 8				
	5½ H^{y} How.	2 ..				
18-Pr.	Carronades	1 ..	5	8 6	14 10	90
	Guns	6 ..				
12-Pr.	Carronades	1 ..	4 8	5 9	9 15	63
	Heavy Guns	4 ..				
	Light Guns	3 ..				
	Howitzers .	1 4				
9-Pr.	Carronades	.. 14	3 8	4 11	7 10	41
	Guns	3 ..				
6-Pr.	Heavy Guns	2 ..	2 8	3	4 15	27
	Light Guns	1 8				

In the new system of firing spherical case shot no regard is paid to the degrees of elevation, but the tangent slide is divided into a number of divisions, each division denoting the range in yards.

The

The upper figures express the nearest distance the shot takes effect, and the und6r figures how far that fire covers the ground afterwards; for example, upon the light 6-pr. tangent slide, the 5th elevation, or the F. elevation, requires the F. fuse; it names the length of the fuze to be six-tenths, and the elevation line is marked $\frac{1060}{1240}$, which shews the fuze is excellent from 1060 yards to 1240 yards. All the fuzes are divided into even tenths of inches, (or half-seconds of time,) and are named with the letters A. B. C. by which means one set of boxes and bags will suit howitzers as well as guns.

The fuze auger, instead of boring out the composition for certain ranges, bores it out to certain letters, and each letter upon the tangent slide will denote where the best effect of the shell will take place.

Ranges with Spherical Case Shot, from Experiments carried on at Penzance with Field Guns.

Medium 12-Pr. Brass.						9-Pounder, Brass.						Heavy 6-Pounder, Brass.					
Letter.	Elevation.	Fuze.		Range.		Letter.	Elevation.	Fuze.		Range.		Letter.	Elevation.	Fuze.		Range.	
				From.	To.					From.	To.					From.	To.
	deg.	in.	dec.	Yds.	Yds.			in.	dec.	Yds.	Yds.			in.	dec.	Yds.	Yds.
B.	$1\frac{1}{4}$	..	2	660	960	B.	$1\frac{1}{4}$	..	2	640	920	B.	$1\frac{3}{8}$	..	2	630	880
C.	$1\frac{3}{4}$	..	3	820	1110	C.	$1\frac{3}{4}$	..	3	800	1060	C.	$1\frac{7}{8}$	..	3	780	1010
D.	$2\frac{1}{4}$	..	4	960	1230	D.	$2\frac{1}{4}$	..	4	930	1180	D.	$2\frac{3}{8}$	..	4	910	1120
E.	$2\frac{3}{4}$	..	5	1080	1340	E.	$2\frac{3}{4}$	..	5	1050	1290	E.	$2\frac{7}{8}$	..	5	1025	1225
F.	$3\frac{1}{4}$	..	6	1195	1445	F.	$3\frac{1}{4}$	..	6	1160	1390	F.	$3\frac{7}{16}$	..	6	1130	1320
G.	$3\frac{3}{4}$	..	7	1305	1545	G.	$3\frac{3}{4}$	..	7	1260	1480	G.	4	..	7	1230	1410
H.	$4\frac{3}{8}$	..	8	1415	1645	H.	$4\frac{3}{8}$	..	8	1360	1570	H.	$4\frac{5}{8}$	..	8	1325	1495
I.	$5\frac{1}{16}$	..	9	1520	1740	I.	$5\frac{1}{4}$	..	9	1455	1655	I.	$5\frac{1}{4}$	..	9	1413	1573
K.	$5\frac{3}{4}$	1	0	1620	1830	K.	$5\frac{3}{4}$	1	0	1550	1740						
L.	$6\frac{1}{2}$	1	1	1720	1920	L.	$6\frac{1}{2}$	1	1	1640	1820						

Ranges with Spherical Case Shot, from Experiments carried on at Penzance, with Field Guns.

Light 6-Pounder.

Letter.	Elevation.	Fuze.		Range. From.	Range. To.
		in.	dec.	Yds.	Yds.
B.	$1\frac{1}{4}$	..	2	570	800
C.	$1\frac{5}{16}$	..	3	720	900
D.	$2\frac{1}{4}$	..	4	845	1040
E.	$2\frac{7}{8}$	..	5	955	1145
F.	$3\frac{1}{8}$	..	6	1060	1240
G.	4	..	7	1160	1330
H.	$4\frac{6}{8}$	..	8	1255	1415
I.	$5\frac{1}{4}$	..	9	1345	1500
K.	$5\frac{7}{8}$	1	0	1430	1580
L.	$6\frac{5}{8}$	1	1	1510	1655
M.	$7\frac{1}{4}$	1	2	1585	1725

Heavy 3-Pounder.

Letter.	Elevation.	Fuze.		Range. From.	Range. To.
		in.	dec.	Yds.	Yds.
A.	1	..	1	370	530
B.	$1\frac{1}{2}$	..	2	560	710
C.	2	..	3	710	830
D.	$2\frac{9}{16}$	..	4	830	960
E.	$3\frac{1}{16}$	..	5	930	1050
F.	4	..	6	1020	1130
G.	$4\frac{5}{8}$	..	7	1100	1200
H.	$5\frac{1}{4}$	..	8	1175	1265

Heavy $5\frac{1}{2}$-Inch Howitzer.

Letter.	Elevation.	Fuze.		Range. From.	Range. To.
		in.	dec.	Yds.	Yds.
B.	$2\frac{3}{4}$	..	2	330	590
C.	$3\frac{1}{4}$	..	3	438	688
D.	4	..	4	534	774
E.	$4\frac{3}{4}$	..	5	622	852
F.	$5\frac{3}{4}$	..	6	704	924
G.	$6\frac{1}{2}$	..	7	782	992
H.	$7\frac{1}{8}$	..	8	857	1060
I.	$8\frac{1}{4}$	..	9	930	1130
K.	9	1	0	1002	1197
L.	10	1	1	1070	1262
M.	$10\frac{3}{4}$	1	2	1140	1325

SPIKE.

SPIKE.—There are two sorts used in the British service.

1*st.* The common steel spike of a conical form is 4 inches in length, the head is $\frac{3}{8}$ of an inch in diameter, and the point $\frac{1}{10}$. This spike requires considerable force to drive it into the vent; and, from its conical form, serves for all natures of ordnance. The part which cannot be driven home in the vent is to be broken off by several smart strokes with a hammer.

2*d.* The spring spike, which is only used when guns are likely to be re-taken from the enemy.

Table of the Dimensions of Spring Spikes.

Nature.			Spike's Length.	Spring's Length.
			Inches.	Inches.
12-Pounder	Heavy & Medium		$7\frac{1}{2}$	$2\frac{3}{4}$
	Light		7	2
9-Pounder			7	$2\frac{1}{2}$
6-Pounder	Heavy		$6\frac{1}{2}$	$2\frac{1}{2}$
	Light		$5\frac{1}{2}$	$2\frac{1}{2}$
Howitzers,	8-Inch		$7\frac{3}{4}$	$3\frac{3}{4}$
	$5\frac{1}{2}$	Heavy	$7\frac{1}{2}$	$2\frac{3}{4}$
		Light.	$6\frac{1}{2}$	$2\frac{1}{2}$
	$4\frac{2}{5}$		$4\frac{3}{4}$	$2\frac{1}{2}$

The best methods of rendering a gun unserviceable, when the time will admit, are as follows:

1*st.* To break, blow, or saw off the trunions.

2*d.* To fire a shot from another piece into the bore, which

which will damage the gun in such a manner, as to prevent the sponge from being introduced.

3*d*. Having first spiked the gun, ram home some clay or lime to the bottom of the bore, and after it a shot enveloped in felt, leather, or wollen cloth. The French use a square steel spike, tempered, except at the point, which is made of sufficient length to pass through the whole of the vent, and project two or three inches within the bore; it is then rivetted inwardly, by being struck forcibly with the rammer-head. Spikes are sometimes formed with a worm like a screw, except towards the point, which is not tempered, and is rivetted as before: this operation requires two hours and a quarter.

Aide Memoire.

Another method of rendering guns unserviceable, is, by firing several rounds of broken shot into the gun, their edges having been previously hardened by immersing them, when red hot, in cold water.

When the time will not allow the gun to be spiked or damaged, No. 2 should be careful to take away with him the sponge, or, after breaking it, fire it out of the gun the last round; the spare sponge, (very inconveniently fixed under the trail,) together with the wad-hook, should be carried away or destroyed. These precautions, simple as they appear, will prevent an enemy turning your guns on you immediately they have taken possession of them.

 Return

Return of Small Stores, Appointments, Camp Equipage, Harness, Artificers' and Intrenching Tools, &c. furnished to a Troop of Royal Horse Artillery and Field Batteries of different Natures.

Ordnance.*		A Troop of Horse Artillery.	Battery of Medium 12-Prs.	Battery of 9-Pounders.	Battery of Heavy 6-Prs.	Battery of Light 6-Prs.	Battery of Heavy 3-Prs.
Ordnance mounted on Travelling Carriages,	Guns....	5	5	5	5	5	5
	Howitzers	1	1	1	1	1	1
Waggons	Ammunition, N.P.	6	6	6	6	6	9
	Baggage	2	2	2	2	2	2
	Forge	1	1	1	1	1	1
Store Carts							
Empty Flannel Cartridges	Guns	125	250	250	250	250	250
	Howitzers	25	50	50	50	50	50
Fuzes graduated	Spherical Case, Guns	250	580	600	756	756	766
	Spherical Case, Howitzers	9	116	116	116	116	116
	Common for Howitzers	93	64	64	64	68	.68
Port-fires		144	72	102	132	132	162

* For the Ammunition, see Tables of different Natures.

Return

Return of Small Stores, Appointments, Camp Equipage, &c.—Continued.

Ordnance.	A Troop of Horse Artillery.	Battery of Medium 12-Prs.	Battery of 9-Pounders.	Battery of Heavy 6-Prs.	Battery of Light 6-Prs.	Battery of Heavy 3-Prs.
Tubes	1200	600	850	1100	1100	1600
Axes with handles — Felling	6	6	6	6	6	6
Axes with handles — Pick	6	6	6	6	6	6
Awls — Brad	6					
Buckets — Water	6	6	6	6	6	6
Boxes — Grease	17	16	16	16	16	6
Covers — Painted — Gun and Howitzer	6	6	6	6	6	6
Covers — Painted — Gun and Howitzer Limber	6	6	6	6	6	6
Covers — Painted — Ammunition Body	6	6	6	6	6	6
Covers — Painted — Ammunition Carriage Limber	..	6	6	6	6	6
Covers — Painted — Forge Waggon	1	1	1	1	1	1
Covers — Wadmiltilts for Baggage Waggons	2	2	2	2	2	2
Compasses, pairs	6	1	1	1	1	1
Cork-screws	6	6	6	6	6	6

Return

Return of Small Stores, Appointments, Camp Equipage, &c.—Continued.

Ordnance.		A Troop of Horse Artillery.	Battery of Medium 12-Prs.	Battery of 9-Pounders.	Battery of Heavy 6-Prs.	Battery of Light 6-Prs.	Battery of Heavy 3-Prs.
Cartouches, of Leather		12	12	12	12	12	12
Dismounting Ropes		6					
Flax	Ounces	6	8	8	8	8	8
Funnels for filling Shells		6	6	6	6	6	6
Hammers	Hand-claw	6	6	6	6	6	6
	Wrench	6					
Hambro' Line	Skains	6	6	6	6	6	6
Lanthorns	Laboratory	6					
	Dark	6					
	Muscovy	6					
Jacks	Hand-screws—small	..	6	6	6		
	Lifting	6	..	..	..	6	6
Match	Slow Skains	6	6	6	6	6	6
	Quick Lengths	172	96	136	216	216	256

Return

Return of Small Stores, Appointments, Camp Equipage, &c.—Continued.

Ordnance.		A Troop of Horse Artillery.	Battery of Medium 12-Prs.	Battery of 9-Pounders.	Battery of Heavy 6-Prs.	Battery of Light 6-Prs.	Battery of Heavy 3-Prs.
Muzzle Caps	Guns	5	5	5	5	5	5
	Howitzers	1	1	1	1	1	1
Measures—Copper	of Sorts	3	12	12	12	12	12
Marline, tanned	Skains	6	6	6	6	6	6
Mallets and Setters	$5\frac{1}{2}$-Inch	6	M.S. 1·2	1·2	1·2	1·2	1·2
Needles		12	12	12	12	12	12
Pockets for Tubes	Leather	12					
Punches for Vents		6	12	12	12	12	12
Priming Wires	Sets	6	6	6	6	6	6
Pincers—pairs	Copper	6	6	6	6	6	6
	Iron	6	1	1	1	1	1
Port-fire, Cutters		6	6	6	6	6	6
Prolongs		6					

Return

Return of Small Stores, Appointments, Camp Equipage, &c.—Continued.

Ordnance.		A Troop of Horse Artillery.	Battery of Medium 12-Prs.	Battery of 9-Pounders.	Battery of Heavy 6-Prs.	Battery of Light 6-Prs.	Battery of Heavy 3-Prs.
Rasps, Half-round		6	1	1	1	1	1
Sponges, with Caps	Guns	10	10	10	10	10	10
	Howitzer Cylinder	2	2	2	2	2	2
Sticks, Portfire		12	12	12	12	12	12
Saws	Hand with Cases	6					
	Tenon	6	6	6	6	6	6
Spikes	Spring	6	6	6	6	6	6
	Common	6	12	12	12	12	12
Straps for Side Arms		62	60	60	60	60	60
Stones, Rag		6					
Scales, Diagonal		6	1	1	1	1	1
Scrapers for Shells		6					
Slings for Guns		6					

Return of Small Stores, Appointments, Camp Equipage, &c.—Continued.

Ordnance.	A Troop of Horse Artillery.	Battery of Medium 12-Prs.	Battery. of 9-Pounders.	Batteries of Heavy 6-Prs.	Battery of Light 6-Prs.	Battery of Heavy 3-Prs.
Spades	6	12	12	12	12	12
Shovels	6					
Sleeves, Laboratory	6					
Scissors	6	6	6	6	6	6
		oz.	oz.	oz.	oz.	oz.
Tow ... lbs	6	4	4	4	4	4
Thum-stalls	6	12	12	12	12	12
Turn-screws	6					
Wad-hooks for Guns	5	5	5	5	5	5
Worsted ... Ounces	6	6	6	6	6	6
Wadmiltilts for Limbers	24					

Return of Small Stores, Appointments, Camp Equipage, &c.—Continued.

Harness and Appointments.	A Troop of H. Artillery.	Field Batteries.
Harness — Rope — Leading ... Pairs	22	Sent according to the nature of the Service.
Harness — Rope — Wheel ... Do.	17	
Harness — Web, (one Horse to a *Set*) ... Sets.	12	
Saddles, Gunners, with Girth and Stirrups	54	
Bridles — Bit and Bradoon	54	
Bridles — Watering	88	
Breast-plates	54	
Brushes — For cleaning Harness	47	
Brushes — For cleaning Carriages	12	
Churns for Farriers	2	
Collar Chains	136	
Collar, (Head Stall)	136	
Cloaks	98	
Coats	47	
Holsters ... Pairs	54	
Bearskin Flounces for Holsters	54	
Horns, Bugle	2	

Return of Small Stores, Appointments, Camp Equipage, &c.—Continued.

Harness and Appointments.	A Troop of H. Artillery.	Field Batteries.
Strings for Bugle Horns	2	
Leggins	47	According to the Sets of Harness
Spunges for cleaning Harness	145	
Saddle Bags	145	
Surcingles	88	
Straps — Baggage, Double	790	
Straps — Baggage, Single	145	
Straps — Cloak, (three to a Set) ... Sets	145	
Swords, with Steel Scabbards	98	
Sword Belts, with Breast-plates and Knots	98	
Spurs ... Pairs	145	
Saches — Staff Serjeants	2	
Saches — Serjeants	3	
Trumpets	2	
Strings for Trumpets	2	
Whips	47	According to the Sets of Harness.

Return of Small Stores, Appointments, Camp Equipage, &c.—Continued.

Camp Equipage.			A Troop of Horse Artillery.	Field Batteries.
Marquees		Subalterns	4	According to the number of Officers and Men, and Nature of the Service.
		Captains	2	
Tents		Mess	1	
		Kitchen	1	
		Flanders	17	
Poles and Pins for	Marquees	Captains	2	
		Subalterns	4	
	Tents	Mess	1	
		Kitchen	1	
		Flanders	17	
Blankets			145	
Bill Hooks			5	
Band Rolls			10	
Chaff Cutters, Portable				
Knives for Ditto				
Canteens, of Wood			145	
Corn Bags			100	
Forage Cords		Sets	24	
Hand Hatchets			14	

Return of Small Stores, Appointments, Camp Equipage, &c.—Continued.

Camp Equipage.	A Troop of Horse Artillery.	Field Batteries.
Haversacks	145	According to the number of Officers and Men, and Nature of the Service.
Hoes	6	
Kettles, Camp	6	
Mauls, of Wood	6	
Nose Bags	136	
Oil Decks	145	
Picket Posts	100	
Picket Rope . . . Fathoms	130	
Pallias Beds and Bolsters . . . of each	146	
Quartern Measures	6	
Rakes	6	
Reaping Hooks	6	
Sacks for Corn	32	
Scythes	6	
Sneds, with Handles for Ditto	6	
Spoons	145	
Trenchers	145	
Tables, Mess	1	

Return

Return of Small Stores, Appointments, Camp Equipage, &c.—Continued.

Artificers' Tools.		A Troop of H. Artillery.	Battery of Med. 12-Prs.	Battery of 9-Pounders.	Battery of Heavy 6-Prs	Battery of Light 6-Pr.	Battery of Heavy 3-Prs
Anvils, with Blocks		1	1	1	1	1	1
Axes, with Handles		2	Sent in the Chests of Tools.				
Awls—sorted	Pannel	3					
	Common	12					
	Sadlers	2					
	Brad	2					
Adze		1					
Augers	of Sorts	6					
Bellows	Pairs	6	1	1	1	1	1
Bick Iron		6	1	1	1	1	1
Bench Hooks		6	Sent in the Chests of Tools.				
Buzzes	Large	6					
	Small	6					
Bevils		6					
Brace, with Bits		1					
Clawed Crows		2					

Return of Small Stores, Appointments, Camp Equipage, &c.—Continued.

Artificers' Tools and Materials.		A Troop of Horse Artillery.	Field Batteries.
Chests	Carriage Smiths	1	Complete Chests of Tools are sent for Wheelers, Collar Makers, and Forge Waggons.
	Wheelers	1	
	Collar Makers	1	
Compasses	Pairs	1	
Chalk-lines, with Rollers		1	
Chissels	Socket	3	
	Mortice	6	
	Tonging	1	
Callipers	Pairs	2	
Clams	Ditto	1	
Cresses	Screw	1	
	Single	1	
Dividers' Spring		1	
Drill Box and Bow		1	
Emery	Fine—lbs.	1	
	Coarse—ditto	1	
	Paper—Sheets	6	

Return

Return of Small Stores, Appointments, Camp Equipage, &c.—Continued.

Artificers' Tools and Materials.		A Troop of H. Artillery.	Field Batteries.
Files, of Sorts	Rough	2	Complete Chests of Tools are sent for Wheelers, Collar Makers, and Forge Waggons.
	Bastard	2	
	Smooth	4	
Guages		2	
Gimblets	Long Spike	9	
	Short Ditto	8	
	Pocket	8	
Gouges	Boxing	1	
	Picking	1	
Hammers	Sledge	1	
	Bench	3	
	Set	1	
	Large Claw	1	
	Hand Ditto	2	
	Wrench	2	
	Saddlers'	2	

Return of Small Stores, Appointments, Camp Equipage, &c.—Contin

Artificers' Tools and Materials.		A Troop of H. Artillery.	Field Batteries.
Irons for Collar-Makers	Hand	2	Complete Chests of Tools are sent for Wheelers, Collar Makers, and Forge Waggons.
	Collar	2	
Knives	Hand	2	
	Round	1	
	Drawing	1	
Mallets	Wheelers'	1	
	Collar Maker	1	
Marline spikes		2	
Needles—sorted	Collar	10	
	Saddlers'	10	
Nippers—Pairs	Collar	2	
	Saddlers'	1	
Punches (sorted) for Collar Makers		9	
Pincers—Pairs	Common	3	
	Saddlers'	1	

Return

Return of Small Stores, Appointments, Camp Equipage, &c.—Continued.

Artificers' Tools and Materials.		A Troop of H. Artillery.	Field Batteries.
Plyers—Pairs	Round Nosed	1	Complete Chests of Tools are sent for Wheelers, Collar Makers, and Forge Waggons.
	Flat Ditto	2	
Planes	Trying, double ironed	1	
	Smoothing, do. do.	7	
	Jack, ditto ditto	2	
Pokers for Forges		1	
Rules, Box, 2 feet	Brass Slide	1	
	Common	3	
Saws	Hand	1	
	Tenon	1	
	Turning	1	
Scissors	Pairs	2	
Stones	Rub	2	
	Rag	2	
	Oil	2	
Spokeshaves	Large	1	
	Small	1	

Return of Small Stores, Appointments, Camp Equipage, &c.—Continued.

Artificers' Tools and Materials.		A Troop of H. Artillery.	Field Batteries.
Sets for Saws		1	Complete Chests of Tools are sent for Wheelers, Collar Makers, and Forge Waggons.
Stools for Collar Makers		2	
Stocks, (Pairs) with Dies & Plugs of different threads		1	
Squares	Iron	1	
	Wood	1	
Screw Plates	Large	1	
	Small	1	
Shears—Pairs	Carriage Smiths	1	
	Collar Makers	1	
Slices for Forges		1	
Turnscrews		3	
Tongs for Forges		3	
Vices	Bench	1	
	Hand	1	

Return of Small Stores, Appointments, Camp Equipage, &c.—Continued.

Artificers' Materials.			A Troop of Horse Artillery.	Field Batteries.
Leather Hides	Black for	Harness	2	According to the Number of Horses and Carriages, and Nature of the Service.
		Bridles	2	
	Brown for	Harness	2	
		Thongs	2	
		Saddle Seats	1	
Basils		Black	3	
		Brown	3	
Buckles		Iron	2	
		Roller	2	
		Patent	2	
		Common	1	
Bristles		Ounces	3	
Brass Cantles for Saddles			10	
Copperas		lbs.	1	
Doe's Hair		lbs.	10	
Dees Iron			1	
Girth, Web		Yards	20	
Greese		Firkins	1	

Return

Return of Small Stores, Appointments, Camp Equipage, &c.—Continued.

Artificers' Materials.			A Troop of Horse Artillery.	Field Batteries.
Nails	Common, of Sorts		100	According to the Number of Horses and Carriages, and Nature of the Service.
	Screw, of Ditto		100	
	Clout	6d.	1000	
		4d.	1000	
		3d.	1000	
		2d.	1000	
Oil—Gallons	Neatsfoot		6	
	Sweet		1	
Rings, Snipe and Bill			2	
Serge	Yards		12	
Soft Solder	lbs.		1	
Tacks—Papers	Large		1	
	Small		1	
Threads—lbs.	Hemp		4	
	Pack		3	
	Seaming		2	
Twine	lbs.		2	
Wax—lbs.	Black		1	
	Bees		1	

Return of Small Stores, Appointments, Camp Equipage, &c. Continued.

Spare.		A Troop of H. Artil.	Battery of M. 12-Pr.	Battery of 9-Prs.	Battery of H. 6-Prs.	Battery of L. 6-Prs.	Battery of H. 3-Prs.
Axles		2	1	1	1	1	1
Ditto Arms		2	2	2	2	2	2
Back-bands, with Tugs		6					
Breechings	Near Side	3					
	Off Side	3					
Bail Hoops for Baggage Waggons							
Coating, for Sponge Heads	Pieces						
Curbs, with Hooks		12					
Curb Hooks	Off Side	12					
	Near Side	12					
Driving Bolts	Small	1	1	1	1	1	1
Elevating Screws	Gun	1	1	1	1	1	1
	Howitzer	1					
Linch Pins		12	12	12	12	12	12
Limber Hooks	Gun	1	1	1	1	1	1
	Howitzer						
Pannels	Gunners						
	Drivers — Nr. side						
	Drivers — Offside						
Staples, for Side-arms		..	20	20	20	20	20
Spunge-heads	Guns	10	5	5	5	5	5
	Howitr Cylindric	2	1	1	1	1	1
Shafts	Near Side	1	1	1	1	1	1
	Off Side	1	1	1	1	1	1
Traversing Handspikes		2	1	2	2	2	2
Trail Plate Eye		1	1	1	1	1	1
Washers		1	1	1	1	1	1
Wheels		1	3	3	3	3	3

TAN

TANGENT.—See the table of natural tangents at the end of the word *Gunnery.*

Tangent Scale.—·21 of an inch is the tangent of 1 degree to every foot of a gun's length, from the base ring to the swell of the muzzle; therefore, if the distance in feet between these two points be multiplied by ·21, the product will be the tangent of 1 degree, from which the dispart being subtracted, will give the length of the tangent scale above the base ring for one degree of elevation for that particular gun. If the scale is to be applied to the quarter-sight of the gun, of course the dispart need not be subtracted.

Tangent of 1 *Degree to the following Ordnance.*

	Length.		Tangent, 1°	Dispart.
	Feet.	In.	Inches.	Inches.
12-Pounder Medium ..	6	6	1·365	1·475
12-Pounder Light....	5	..	1·05	1·
6-Pounder Heavy....	7	..	1·47	1·32
6-Pounder Light.....	5	..	1·05	1·
3-Pounder Heavy....	6	..	1·26	1·08
10-Inch Howitzer.....	3	11½	·84	
8-Ditto............	3	1	·64	
5½-Ditto Light.......	2	2¾	·47	

If the tangent scales of field pieces and howitzers were marked with a double index, one shewing the degrees, and the

the other the corresponding distances, it might be of considerable advantage, when the direction of the gun happens to fall to an unexperienced non-commissioned officer, or, as is frequently the case in action, to a gunner.

Tangent of 1 *Degree to the following French Guns.*

Nature of Ordnance.	Siege.		Field.	
	Tangent of 1 Deg.	Dispart.	Tangent of 1 Deg.	Dispart.
	In. Li. P.	In. Li. P.	In. Li. P.	In. Li. P.
24-Pounder....	2 1 5	1 2 4		
16-Ditto.......	2	1 1		
12-Ditto.......	1 10 6	1	1 4 ..	1 3
8-Ditto.......	1 8 3	1	1 2 —½	1 2
4-Ditto.......	.. .. ..	.. .. ..	1	1
6-Inch Howitr.	.. .. ..	.. .. ..	0 5 6	

As the French tangent scales are marked off in inches and lines, the above dimensions are given in the same, for the more ready turning the French elevations into degrees, and thereby comparing their ranges with the English.

TENT—for Laboratory Works.—Weight complete, with poles, pins, &c. 3 cwt. 24 lbs.; length of ridge pole, 18 feet; length of poles, 14½ feet.

Bell Tent, now used for infantry or cavalry; weight complete, with poles, 43 lbs.; length of pole, 9 feet; contain 12 men each; require 40 pegs.

Marquee.

Marquee.—Weight complete, 1 cwt. 17 lbs.; ridge pole, 7 feet; standard, 8 feet.

TONNAGE.—The usual method of finding the tonnage of any ship, is by the following rule:—Multiply the length of the keel by the breadth of the beam, and that product by half the breadth of the beam, and divide the last product by 94, and the quotient will be the tonnage.

Ship's keel, 72 feet; breadth of beam, 24 feet.

$$\frac{72 \times 24 \times 12}{94} = 220 \cdot 6 \text{ tonnage.}$$

The tonnage of goods and stores is taken sometimes by weight and sometimes by measurement; and that method is allowed to the vessel which yields the most tonnage. In tonnage by weight, 20 cwt. make 1 ton. In tonnage by measurement, 40 cubic feet equal 1 ton. All carriages, or other stores, to be measured for tonnage, are taken to pieces, and packed in the manner which will occupy the least room on board-ship. All ordnance, whether brass or iron, is taken in tonnage by its actual weight. Musquet cartridges in boxes or barrels; all ammunition in boxes, and other articles of great weight, are taken in tonnage, according to their actual weight.—See also the word *Embarkation.*

The following is the tonnage required for some of the most material ordnance stores.

Tonnage of Ordnance.

Nature.		N°.	T.	Ct.	Qr.
Axes, complete, with handles	Pole	264	..	10	0
	Pick	100	..	9	0
	Felling ...	176	..	14	0
Barrows—Wheel, packed		20	2	2	0
Ditto, unpacked...........		7	1	0	0
Hand, single		20	0	18	0
Budge barrels		32	1	0	0
Bricks		1000	2	5	0
Buckets of leather		20	0	2	0
Pontoon and carriage, complete, with its appurtenances		....	11	0	0
Carbines.—A chest with 25 stand is 11 feet cubic.					
Carriages—Standing	42-Pounders		1	13	0
	32-Pounders		1	10	0
Howitzer	10-Inch....		1	10	0
	24-Pounders		1	9	3
Howitzer	18-Pounders, 8-Inch....		1	7	0
	12-Pounders		1	4	0
	9-Pounders		1	3	0
	6-Pounders		1	0	0
	4-Pounders		0	17	0
Carriages.——Travelling, complete, with limber-boxes, ladles, sponges, and rammers	24-Pounders		5	10	0
	12-Pounders		4	10	2
	9-Pounders		4	7	2
	6-Pounders		3	7	2
	3-Pounders		2	19	0
Medium	24-Pounders, 12-Pounders		2	9	2
6-Pounder light, with ammunition boxes; $5\frac{1}{2}$-inch howitzer, ditto			2	3	0

Tonnage of Ordnance.—Continued.

Nature.		N°.	T.	Ct.	Qr.
5½-howitzer of 10 cwt.	Carriages		3	2	0
8-inch howitzer	Carriages		3	7	2
Sling-cart, complete			3	0	2
Forge-cart, with limber			3	0	0
Ammunition waggon			4	18	1
Gravel-cart			2	16	2
Duke of Richmond's close-bodied waggon			5	0	0
Road waggon, with upright sides			7	10	0
Gin, triangle			0	14	0
Grate for heating shot			0	4	2
Handspikes		120	1	0	0
Handcrow levers, of 5 feet		120	1	0	0
Handscrews—large		15	1	0	0
small		17	1	0	6
Helves—Pick or felling		300	0	14	0
Ditto Sledge		300	1	0	0
Ditto Pinmaul		360	1	0	0
Junk		20 cwt.	1	5	0
Linstocks, with cocks		600	1	0	0
without cocks		1000	1	0	0
Musquets.—A chest with 25 is 16 feet.					
Ditto with 20 is 11 feet					
Match		cwt.	1	14	0
Powder	11 whole barrels		1	0	0
Powder	22 half ditto		1	0	0
Pitch or tar.—1 barrel is 7 feet					
Pistols.—A chest with 50 or 60 = 10 feet					
Park pickets		40	0	9	1
Pikes		280	1	0	1

Tonnage

Tonnage of Ordnance.—Continued.

Nature.		Nº	T.	Ct.	Qr.
Sheep skins		12 dozen.	1	1	0
Shovels ..	of iron	100	1	0	0
Spades ...	of iron	184	1	0	0
Shovels, shod with iron		138	1	0	0
Sand bags Bales....	Bushel	500	0	12	0
	½ Ditto	500	0	7	1
	2 Bushel	250	0	8	1

The following is the tonnage allowed to the military officers of the ordnance embarked for foreign service, for their camp equipage and baggage:

For a field officer.............5 tons.
For a captain.................3 ditto.
For a subaltern...............1½ ditto.

12th June, 1799.

TRANSPORTS.—See the word *Embarkation.*

TRENCHES.—A general term for all the approaches at a siege of a fortified place.

The approaches at a siege are generally carried on upon the capitals of the works attacked; because the capitals produced are, of all other situations in the front of a work, the least exposed to the fire of either the cannon or musquetry; and are the least in the line of fire between the besieged and besieger's batteries. But if, from particular circumstances,

circumstances, these, or other advantages, do not attend the approaches upon the capitals, they are by no means to be preferred to other positions.

The trenches of communication, or zig-zags, are 3 feet deep, 10 feet wide at bottom, and 12 feet at top, having a berm of one foot, beyond which the earth is thrown to form a parapet.

The parallels or places of arms of the trenches are 3 feet deep, 12 feet wide at bottom, and 17 or 18 feet wide at top, having a banquette of about 3 feet wide, with a slope of nearly as much.—See the word *Sap*.

The first night of opening the trenches, the greatest exertions are made to take advantage of the enemy's ignorance as to the side of attack; and they are generally carried on as far in advance as the first parallel, and even sometimes to the completion of that work. The workmen set out on this duty, each with a fascine of 6 feet, a pick-axe, and a shovel; and the fascines being laid so as to lap one foot over each other, leaves 5 feet of trench for each man to dig.

The usual method of directing the trenches or zig-zags, is by observing during the day some near object in a line with the salient parts of the work, and which may serve as a direction in the night; or if the night be not very dark, the angles of the works may be seen above the horizon; but as both these methods are subject to uncertainty, the following is proposed to answer every case:—

Having

Having laid down the plan of attack, the exact positions of the flanked angles of the works of the front attacked, and particularly of those most extended to the right and left, mark on the plan the point of commencement for the first portions of zig-zag; the point where it crosses the capital; and the point to which it extends on the other side of the capital: this last point will be the commencement of the second branch; then mark off the point where this branch crosses the capital, and its extent on the other side, and this will give the commencement of the third branch; and and so on for the others. Thus provided with a plan ready marked off, it will be very easy, even in the darkest night, to lay down the points where the zig-zags are to cross the capital, and the points to which they are to be produced beyond them. The first parallel is generally run about 600 yards from the place, and of such extent as to embrace the prolongations of the faces of all the works which fire upon the trenches; and each end has a return of about 30 or 40 yards.

The second parallel is constructed upon the same principles, and of the same extent as the first; at the distance of about 300 yards from the salient angles of the covert-way. This parallel is usually formed of gabions, each workman carrying a gabion, a fascine, a shovel, and a pick-axe. After this the trenches are usually carried on by sap.—See that word.

The half parallels are about 140 or 150 yards from the

covert-way,

covert-way, and extend on each side sufficient to embrace the prolongation of all the branches of the covert-way.

The third parallel must not be nearer than the foot of the glacis, or it will mask the ricochet batteries. It is generally made rather wider than the other parallels.

Cavaliers of the trenches must not be nearer than 28 yards from the covert-way, or they will be liable to be annoyed by hand-grenades.

See likewise the words *Approaches*, *Sap*, and *Battery*.

TROOP—of horse artillery—the establishment on home and foreign service during the late war.

	Captain.	2d Captain.	Lieutenants.	Staff Serjeants.	Serjeants.	Corporals.	Bombardiers.	Gunners.	Drivers.	Trumpeters.	Farriers and Smiths.	Collar-Makers.	Wheelers.	Total.	Horses.
Foreign Service.	1	1	3	2	3	3	7	90	60	1	4	2	1	178	164
Home Service.	1	1	3	2	3	3	5	78	47	1	4	2	1	151	136

TROUP-DE-LOUP.—A cone reversed.—Diameter of the base, 4 feet 6 inches; depth, 6 feet; picket, 6 feet long, and from four to five inches square. Contain three-fourths of

of a cubic fathom of earth, and are usually placed 2 in 3 fathoms.

TRUNION-HOLES.—To field guns, carriages for heavy metal, travelling trunion-holes, or, as they are called by the French, *Encastremens de Route*, have been lately added: they should be situated 4 diameters behind those in which the gun is placed for action; by this means the weight of the gun is divided more equally between the axletrees of the limber and gun-carriage.

TUBES—of tin-plates, are generally used. They must pass through a guage of two-tenths of an inch in diameter. The composition is mealed powder, mixed stiff with spirits of wine. They are made up in bundles of 100 each. Brass tubes, although more expensive in the first instance, by their durability appear to answer better than tin, as they do not corrode when exposed in damp situations. After remaining three years in the Martello towers, on the coast of Sussex, they have been found as perfect and good as they were on the day they were put there; whilst the tin ones, after remaining the same time, were rendered totally unserviceable. Tubes may be made of quills, paper, or small reeds; if reeds are used, split the top cross-ways, and place two bits of quick-match at right angles in the cleft; prime over as usual with mealed powder and spirits of wine.

Length of Tin Tubes.

Length	Nature of Ordnance.					
	Heavy.	Med.	Light.	Howr.	Land Mort$^{rs.}$	Sea Mortars.
Inch.	Pr.	Pr.	Pr.	Inch.	Inch.	Inch.
12·2	..	—	—	..	—	13
8·8	24	24				
8·2	18	18				
7·75	12	12	—	—	13	10
6·8	9	9				
6·5	6	—	24	8	10	
5·9	3	6	12	5½		
5·0	..	—	—	..	8	
4·75	1½	1½	6			
4·2	—	—	—	4⅖	5½	
3·6	—	—	—	—	4⅖	

Note.—If tin tubes get damaged by wet, the composition may be cleared out of them, and they may be fresh filled. If spirits of wine cannot be had, good rum or brandy will answer the purpose.

UNSPIKE.

UNS

Unspike.—If a gun is spiked with the common spike, load with rather more than a third of the shot's weight of powder; soak two wads in a solution of saltpetre, and when dry, place a shot between the wads, which must not be made too high; bind them together with long strands of quick-match, and ram the whole home on the charge; put an ounce or two of gunpowder in the copper ladle, and scatter it along the whole length of the bore; then fix a wad or turf in the muzzle of the piece, with half a portfire passed through it, by which means the gun may be easily fired. If this does not cause the spike to remove, repeat the experiment with an additional shot or wad. With brass guns, it would be adviseable, a day or two previous to the experiment, to scratch close round the spike with a graver, and put a few drops of aquafortis in the circle, which, in a few hours, will find its way down between the spike and the metal, particularly if the former is not perfectly round. When a gun is rendered unserviceable, by means of an enveloped shot, suspend it by the muzzle, and fill the bore with live charcoal which will sometimes burn the envel-

lope,

and the shot will roll out. When a screw spike is found in a gun, the only means of rendering it serviceable, is to drill another vent, about half an inch from the original one, on the side of it: the drilling will take up an hour per inch. The bits used must be of different lengths, beginning with a short one. In attempting to drill out a spike, if great care is not taken, the bits will fly off from the hard steel to the metal on the side; by which means, if you at last succeed, the vent will be greatly enlarged. The best method of drilling out a spike, is to use a very small drill first, quite through the spike, and afterwards one rather less than the diameter of the vent. This operation is tedious, and requires more than double the time for boring a new vent.

VELOCITY.

VEL

VELOCITY.—Initial velocity of military projectiles, as ascertained by the experiments with the Balistic pendulum at Woolwich, in 1788, 1789, and 1790.—These experiments were made with shot of equal diameters, power of equal strength, and under a mean height of the barometer; and shew,

1. That there is very little difference in the velocities of shot fired from guns of the same length, but of unequal weights; the advantage being sometimes in favour of one and sometimes the other.

2. That velocities arising from firing with different quantities of powder, are nearly in the proportion of the square roots of the quantities or weights of powder.

3. That the velocities decrease as the distance increase, arising from the resistance of the air, which opposes the progress of the shot, in a proportion somewhat higher than the squares of the velocities throughout, and only to a small variation.

4. That very little advantage is gained in point of range, by increasing the charge more than is necessary to attain the object, the velocities given by large charges being very soon reduced to these by moderate charges: those, for instance,

stance, given by half the shot's weight, are reduced to an equality with those by one-third, after passing through a space of only 200 feet.

That very little advantage is also gained by increasing the length of guns; the velocity given by long guns of 22 calibres length of bore, being, reduced to an equality with those of the short guns of $15\frac{1}{2}$ calibres, with similar charges, after passing through the spaces, as follows:

With $\frac{1}{2}$ the shot's weight	.....	285 feet.
$\frac{1}{3}$ Ditto	.....	200
$\frac{1}{4}$ Ditto	.....	150
$\frac{1}{6}$ Ditto	.....	115

6. That the resistance of the air against balls of different diameters, with equal velocities, is very nearly in the proportion of the squares of their diameters: or as their surfaces.

7. That the velocity is not affected by compressing the charge more or less; or by heating the piece in different degrees.

8. That a very great increase of velocity arises from a decrease of windage; it appearing that, with the established windage of one-twentieth, between $\frac{1}{3}$ and $\frac{1}{4}$ of the force is lost.

9. It also appeared that, by firing the charge in different parts; by varying the weight of the gun to lessen the recoil; or even by stopping the recoil entirely, no sensible change is produced in the velocity of the ball.

 10.

10. That though the velocity of the shot is increased only to a certain point peculiar to each gun, (a further increase of powder, producing a diminished velocity,) yet the recoil of the gun is always increased by an increase of charge.

11. Velocity of a light 6-pr.—length, 4 feet 3 inches; charge, $\frac{1}{3}$ the weight of the shot; 1558 feet per second—6-prs heavy; 6 feet 8 inches; charge, $\frac{1}{3}$=1671 feet per second.

Velocity of a light 3-pr.—length, 3 feet 4 inches; charge, $\frac{1}{3}$=1371 feet per second.

Ditto heavy 3-pr.—length, 5 feet $9\frac{1}{2}$ inches; charge, $\frac{1}{3}$ the shot=1514 feet. HUTTON.

The spaces that a heavy body will freely fall through in a second, in the latitude of London, has been computed to be $\frac{11}{120}$ feet. *Universal Cambist.*

According to Dr. Hutton, a heavy body falls $16\frac{1}{12}$ feet in one second, and at the end of that time acquires a double velocity. That the velocities are directly proportionate to the times, and the spaces to the squares of the times.

All bodies, whether light or heavy, fall perpendicularly through equal spaces in the same time, abstracting for the resistance of the air, as lead, gold, and a feather, which in an exhausted receiver fall from the top to the bottom in the same time.

Velocity

Velocity of French Ordnance.

24-p. charge 8lbs. the eprouvette mortar giving 125 fathoms, the initial velocity is 1425 feet per second; with the eprovette at 90 = 1209 feet; with a charge of 12lbs. and the eprovette at 125, the initial velocity will be 1530.

	Charge.	Eprovette		Velocity
16-Pr.	5 lbs	125		1415
——	8	do.		1510
12-Pr.	4	do.	long guns	1520
8-Pr.	2½	do.	long guns	1418
——	3	do.	long guns	1460
4-Pr.	1	do.	long guns	1335
——	1½	do.	long guns	1508
12-Pr.	4	do.	field guns	1442
8-Pr.	2½	do.	field guns	1422
4-Pr.	1½	do.	field guns	1446
8-Inch How^r^.	1	do.		39
——	1 2 oz.	do.		510
6-Inch How^r^.	1	do.		532
——	1 12	do.		704

Lombard's Tables.

VENT.—The vents of English guns are all $\frac{2}{10}$ of an inch diameter.—See remark 9 of the Article *Velocity.*

In consequence of the enlargement of the vents of *iron* guns at the sieges of Badajos and St. Sebastion, a trial was made at Woolwich, September and October, 1813, with 4 iron 24-pounders, to ascertain what number of rounds they were capable of sustaining, without injury, when the fire was incessant—2 of the 24-pounders had common vents, the

the 3d a wrought iron one, and the 4th one of copper. In three days 400 rounds were fired from each, and the result appears to be, that the copper vent resisted the best, and was scarcely at all enlarged; that of wrought iron afforded considerable resistance; but the common vents were greatly increased in size. This experiment should have been pushed much farther, to from 2 to 3000 rounds a gun, and at the rate of 500 rounds in 24 hours fired from each, not only to ascertain most fully the metal of most resistance with which iron guns should be bouched, but to shew in what degree the cylinders of the pieces would be injured.

WEI

WEIGHTS.—See *Measures.*

WHEEL CARRIAGES.

Those attached to batteries of 12, 9, and heavy 6-pounders, carry each 1 gun wheel and 2 ammunition carriage wheels. Those of light 6-pounder and heavy 3-pounder 3 light wheels, which serve equally for guns or ammunition carriages. The wheel carriages make a spare gun carriage. For the 9-pounder the light wheels will suit for the gun limber, as well as for the whole of the ammunition carriage.

WHEELS—Dimensions of.

Nature of Wheel.	Height.		Length of Boxes.		Diameter of Boxes.		Width of the Tire.	Weight of a Pair.		
					Body.	Linch.				
	Ft.	I.	Ft.	I.	In.	In.	In.	ct.	qr.	lb
Heavy, used for 12-Prs. 9-Prs. Heavy 6-Prs. 24-Pr. Howitzers & Heavy $5\frac{1}{2}$-in. Howitzers.	5	..	1	2	$3\frac{1}{8}$	$2\frac{1}{16}$	$2\frac{3}{4}$	4	0	26
Light, for Light 6-Prs. 12-Pr. Howitzers, Heavy 3-Prs. N. P. Ammunition Carriages, Hind Wheels of Waggons, Pontoon Carriages, and Ball Cartridge Waggons..................	5	..	1	1	$2\frac{3}{4}$	$1\frac{3}{4}$	$2\frac{1}{2}$	3	2	7
Light 3-Pr. Carriage and Limber, Hand Cart, 1-Pounder..........................	4	4		11	2	$1\frac{1}{2}$	$2\frac{1}{4}$	1	3	20
Pontoon Carriage Fore Wheels, F. P. Waggons, Ditto; Trench Cart, Limbers for 12-Pr. Iron Gun, 9-Pr. ditto, and 24-Pr. Iron Howitzer..	4	2	1	1	$2\frac{3}{4}$	$1\frac{3}{4}$	$2\frac{1}{2}$	2	3	20

Dimensions of Wheels.—Continued.

Nature of Wheel.	Height. Ft.	Height. I.	Length of Boxes. Ft.	Length of Boxes. I.	Diameter of Boxes. Body. In.	Diameter of Boxes. Linch. In.	Width of the Tire. In.	Weight of a Pair. ct.	qrs.	lb.
8-Inch Howitzer, 18-Pr. 12-Pr. 9-feet Gun......	5		1	4	$3\frac{1}{2}$	$2\frac{1}{2}$	4	6	2	7
Limbers of 8-inch Howitzer, 24-Pr. Howitzer, 24-Prs. 18-Prs. and 12 Prs. 9-Feet.........	3	10	1	2	$5\frac{1}{8}$	$2\frac{1}{16}$	$4\frac{1}{4}$	3	2	27
Carriage of 24-Pr. of 50cwt. or $9\frac{1}{2}$ feet 10-inch How^{r}.	5		1	6	$3\frac{3}{4}$	$2\frac{3}{4}$	5	7	1	2
Devil Carriage, Hind........................	7	0	1	4	$3\frac{1}{2}$	$2\frac{1}{2}$	5	11	0	24
Devil Ditto, Fore, and Platform Carriage, Hind...	5	0	1	2	$3\frac{1}{8}$	$2\frac{1}{16}$	4	5	2	7
Platform Ditto, Fore, and Sling Waggon, Hind...	4	0	1	2	$3\frac{1}{8}$	$2\frac{1}{16}$	4	4	2	2
Sling Cart..............................	5	0	1	4	$3\frac{1}{2}$	$2\frac{1}{2}$	5	7	2	1

Note.—The wheels for the Guns, Limbers, and Ammunition Carriages, have brass boxes. Those for the Waggons, Carts, &c. have iron boxes.

WINDAGE.

WINDAGE.—The usual windage of English guns is one twentieth of the caliber. It appears by experiments, that $\frac{1}{4}$, or nearly $\frac{1}{3}$, of the force of the powder is lost by this windage. See remark 8 of the word *Velocity*.

An excess of windage in any piece of ordnance tends to render it unserviceable, because the shot strikes the interior of the bore, when fired, under a greater angle, and, consequently, more frequently before it quits the piece; which blows, as the gun becomes hot, take greater effect, and frequently render it unserviceable, before any bulge or exterior imperfection is to be perceived. For the same reason, the shot is deflected from the true line of fire, and the elastic fluid which propels the shot escapes more freely, having a greater vent, consequently, its effects are not so violent on the shot itself, and its range is diminished. This diminution of range may also, in some measure, be attributed to the axis of the shot lying below the axis of the bore, and thus the force of the elastic fluid does not act direct on the centre of the shot, more or less so according to the degree of windage. The deflection of the shot is of much more consequence than the diminution of range, as all guns carry their shot as far as any true aim can be taken with them, or any great effect expected from a longer range.

Windage of Guns and Carronades.

Natures.	68	42	32	24	18	12	9	6	4	3	2	1
Guns ..	..	·33	·30	·27	·25	·22	·20	·17	·15	·14	·12	·09
Carron^es	·15	·15	·15	·14	·12	·12						

Windage of Mortars and Howitzers.

From the 13 to $5\frac{1}{2}$-inch the windage is ·15 of an inch, and that of the $4\frac{2}{5}$ is ·2 of an inch.

Windage of French Guns.

Field Guns.—All one line of windage; about one-fiftieth in an 8-pounder.

Siege Guns.—All $1\frac{1}{2}$ line; about one forty-eighth in a 24-Pr.

Mortars—12-Inch; 4 lines of windage.
10-Inch; 1 line, 6 points do.
8-Inch; 1 line, do.

Howitzers.—All; 2 lines, do.

WOOD.—Artillery carriages are generally made of elm, ash, and oak. The bed and house of a sea mortar are made of oak,* and the bolster of elm. The bottoms of land mortar beds are of oak, and the upper parts of elm.

* It has been proposed and intended to make the beds of all sea mortars of cast iron.

Carriages

Carriages—Ship—The cheeks, transoms, and trucks of elm; the axle-trees of oak.

——— *Garrison.*—The whole of oak; trucks, iron.

——— *Field.*—Heavy 24 and 12-Pr.; the cheeks and transoms of elm; the axle-trees of ash.—In the wheel, the nave and fellies are of elm, the spokes of ash; limber, shafts, bars, and axle-trees are of ash.—Light guns, from 3 to 12-Prs. the cheeks and transoms are of elm; the ammunition boxes are of fir.—In the wheels, the nave is of elm, the spokes of oak, and the fellies of ash.—In the limber the shafts and bars of ash.

THE END.

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Printed by G. Hayden, Little College Street, Westminster.